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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Recent Caledonian Locomotive Practice.—No. II.

Beardmore-Tosi Diesel Engine.

Fog-Signalling by Polarised Sound.

The Motor Show.

Developments in Power Station Design.—No. XV.

White Lead in Painting.

Stainless Steel and its Properties.

An Automatic Mechanical Train Controller

Tests of an Aero Engine.

PUBLIC NOTICES

India Store Department,
Belvedere-road,
Lambeth, S.E. 1.
10th November, 1921.

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of—
(1) STEEL BOILER TUBES.
(2) BRAKE TRUSS BARS.

Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Thursday, the 1st December, 1921.

T. RYAN,
Director-General.
6658

First Engineer and Dredging MASTER REQUIRED by the GOVERNMENT of CEYLON, for three years' service, with possible extension, salary, £320 a year, rising to £360 a year by annual increments of £20, plus a temporary increase of 33 1-3 per cent. House allowance of 7½ per cent. of salary if a bachelor, or 11 per cent. if married. Salary paid in rupees at 15 to the pound sterling. Free passages provided.

Candidates, aged about 35, preferably single, must be fully qualified to Take Charge of the Engines, Machinery and Dredging Operations of one of the Colombo Harbour Dredgers; must hold a First-class Board of Trade Engineering Certificate, and have had extensive experience in Dredging.—Apply at once in writing, giving age, brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Ceylon 11,181.
6688

Aberdeen Corporation Water-Works.
EXTENSIONS, 1920.
CONTRACTS Nos. 4 and 5.—NEW AQUEDUCT.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into contracts for the CONSTRUCTION of (a) about ¾ Mile of 4ft. CONDUIT, partly in tunnel, (b) about ¾ Mile of 4ft. CONDUIT.

The drawings may be inspected and specifications, schedules of quantities and forms of Tender obtained on and after 21st November, 1921, on application at the Water Engineer's office, 411, Union-street, Aberdeen.

For each specification of each contract a deposit of Five Pounds sterling in cash will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification and schedule of quantities provided, with the schedule of quantities and other schedules fully priced out in detail, and shall not have withdrawn the same. Provision is made for adjustment of the contract sum to meet alterations in the cost of labour and materials.

Tenders on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for New Aqueduct," and addressed to the undersigned, must be delivered not later than 9th December, 1921.

The Town Council do not bind themselves to accept the lowest or any Tender.

GEORGE MITCHELL, M.I.Mech.E.,
Water Engineer.

Water Engineer's Office,
411, Union-street, Aberdeen,
9th November, 1921. 6669

Auckland Harbour Board.
TENDERS FOR MILD STEEL OR IRON GATES AND FENCES.

TENDERS will be received until January 10th, 1922, for the SUPPLY of MILD STEEL or IRON GATES and FENCING for Quay-street frontage, Auckland.

Specifications and forms of Tender may be obtained on application to the undersigned, and drawings may be inspected at their address.

Tenders must be endorsed on envelope "Tender for Gates and Fencing," and must be accompanied by a deposit of £50 under separate cover, both addressed to W. and A. McArthur, Ltd., the Loudon agents for the Auckland Harbour Board.

Tenders will be forwarded to Auckland, but the deposits will be retained in London and returned to unsuccessful tenderers on receipt of a cable from Auckland.

The lowest or any Tender not necessarily accepted.

By Order of the Board,
W. and A. McARTHUR, Ltd.

Canberra House,
18/19, 8ilk-street,
Cripplegate, London, E.C. 6682

Great North of Scotland Railway Company.
CONTRACTS FOR STORES.

The Directors of the Great North of Scotland Railway Company are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES for six or twelve months (in the Company's option), from 1st January, 1922:—

	No. of form.		No. of Form.
Brooms, Brushes, &c.	1	Glass (Plate and Sheet)	
Canvas, Ropes, Flax, and Twine	2	Lamp Chimneys, &c.	14
Carriage Cloth and Trimmings	3	Handles (Hammer, &c.) and Shunting Poles	15
Carriage Furnishings (Locks, Hinges, &c.)	4	India-rubber Goods, Baltic Belting, and Engine Packing	16
Cement and Lime	5	Iron Castings	18
Chamois Skins and Sponges	6	Ironmongery	19
Cotton Waste, Lamp Wick, Sponge Cloths, Flannel, &c.	7	Leather	22
Crucibles	8	Nails, Tacks, Taper Pins, Screws and Cotter Pins	24
Drysalteries	9	Soap and Candles	27
Files, Steel and Steel Castings	11	Screws (Wood) and Washers	28
Fireclay, Bricks, Pipes, &c.	12	Springs (Bearing, Buffing, &c.)	29
Galvanised Fencing, and Signal Wire and Steel Tail Ropes	13	Transfers (Carriage, &c.)	32
		Telegraph Material	33a

Forms of Tenders can be obtained from the Stores Superintendent, 80, Guild-street, Aberdeen, on payment of One Shilling for each form.

Patterns may be inspected at the Stores Depot, Inverurie, between the hours of 10 a.m. and 4 p.m., from Monday, 21st November, to Monday, 5th December, inclusive, except on Saturdays, 26th November and 3rd December, when they will not be on view after Twelve o'clock Noon.

Tenders, endorsed "Tender for Stores," must be lodged with the undersigned not later than 10 a.m. on Thursday, 8th December next.

The Directors do not bind themselves to accept the lowest or any Tender.

T. S. MACKINTOSH,
Secretary.

Company's Offices,
80, Guild-street, Aberdeen,
7th November, 1921. 6626

PUBLIC NOTICES

Corporation of Madras.
SPECIAL WORKS DEPARTMENT.
CONTRACT M & M No. 41.
STONEWARE PIPES AND SPECIALS.

The Corporation of Madras, India, is prepared to receive TENDERS from competent persons, willing to enter into a contract, for the SUPPLY and DELIVERY of STONEWARE PIPES and SPECIALS, varying from 4in. to 18in. diameter, and aggregating a total length of about 58 miles.

Forms of Tender, prepared by J. W. Madeley, Esq., M.A., M. Inst. C.E., M. Am. Soc. C.E., &c., Special Engineer to the Corporation of Madras, may be obtained from the undersigned Agents of the Corporation, on payment of Five Shillings per set, which will not be returned.

Tenders, accompanied by a deposit in currency notes or a draft on the Imperial Bank of India for Rs. 200, should be sent direct to the Commissioner, Corporation of Madras, so as to reach him at or before Twelve o'clock Noon on the 23rd January, 1922.

The Corporation does not bind itself to accept the lowest or any Tender.

JAMES MANSERGH and SONS,
Agents to the Corporation.

5, Victoria-street,
Westminster, S.W. 1.
3rd November, 1921. 6612

London County Council.
CHARLTON STORM RELIEF SEWER.

TENDERS are INVITED for a CONCRETE, REINFORCED CONCRETE and an IRON SEWER of varying sizes, of a total length overall of nearly three-quarters of a mile, together with an outlet into the river Thames. The work will be wholly situated in the Metropolitan Borough of Greenwich.

Persons desiring to tender may obtain the drawings, specifications, bills of quantities, form of Tender, &c., on application to the Chief Engineer at the County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of the sum of £5. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specification and other contract documents may be inspected at the County Hall before the payment of the fee.

No Tender received after Twelve Noon on Tuesday, 29th November, 1921, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.
6655

London County Council.
HAMMERSMITH STORM RELIEF SEWER.

TENDERS are INVITED for a BRICK and CONCRETE SEWER of varying sizes, of a total length overall of nearly 1¼ miles, together with an outlet into the river Thames. The work will be situated in the Metropolitan boroughs of Kensington, Fulham and Hammersmith.

Persons desiring to tender may obtain on and after Monday, 14th November, 1921, the drawings, specifications, bills of quantities, form of Tender, &c., on application to the Chief Engineer at the County Hall, Spring-gardens, S.W., upon payment to the Chashier of the Council of the sum of £5. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specification and other contract documents may be inspected at the County Hall before the payment of the fee.

No Tender received after Twelve Noon on Tuesday, 29th November, 1921, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.
6656

PUBLIC NOTICES

Borough Polytechnic Institute,
BOROUGH-ROAD, LONDON, S.E. 1.

REQUIRED, a LECTURER in Practical Mathematics for Monday, Tuesday, and Friday evenings, from 7 to 9.15, commencing the last week in November. Remuneration at the rate of 15s. per evening plus 20 per cent. (conditional). Applications should be addressed to the undersigned.

C. T. MILLIS, Principal.
6681

Metropolitan Water Board.
WALTON TO HONOR OAK MAIN.
SECTION No. 2.
TENDER FOR THE LAYING OF 48in. MAIN, MALDEN TO CLAPHAM PARK.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of about 11,400 LIN. YARDS of CAST IRON WATER MAIN, 48in. in diameter, from Coombe-road, Malden, to Thornton-road, Clapham Park, in the Counties of Surrey and London, through public and private roads, fields, &c., together with contingent works.

Drawings, conditions of contract, and specification may be inspected without payment of fee at the offices of the Board, Chief Engineer's Department (Room 201), New River Head, 173, Rosebery-avenue, Clerkenwell, E.C., on and after Monday, 14th November, 1921.

Forms of Tender, conditions of contract, specification, bills of quantities, and schedules of prices, together with a spare copy of the bills of quantities and schedules of prices, may be obtained on and after the 14th November, 1921, from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £20, which sum must be deposited with the Accountant to the Board at 173, Rosebery-avenue, Clerkenwell, E.C. 1, and will be returned on receipt of a bona fide Tender, together with all the above-named documents (with the exception of the spare copy of the bills of quantities and schedules of prices, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon).

Tenders, enclosed in sealed envelopes addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Main, Walton to Honor Oak, Section No. 2," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 19th December, 1921.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue,
Clerkenwell, E.C. 1.
31st October, 1921. 6580

Newton Abbot Rural District Council.
HENNOCK WATER SUPPLY.

TENDERS are INVITED for SUPPLYING, DELIVERING and LAYING about 820 Yards of 3in. CAST IRON WATER MAINS, together with requisite fittings and works in connection with the above undertaking, including a small RESERVOIR to hold 5000 gallons.

Drawings may be seen and copies of specifications, bills of quantities and forms of Tender obtained at my office on payment of the sum of £2 2s., which will be returned upon receipt of a bona fide Tender and the return of all the documents.

Sealed Tenders, endorsed "Hennock Water Supply," are to be delivered at my office not later than Ten o'clock on Tuesday, the 22nd instant.

The lowest or any Tender not necessarily accepted.

By Order,
F. HORNER,
Clerk to the Council.

Council Offices,
64, East-street, Newton Abbot,
7th November, 1921. 6633

PUBLIC NOTICES

The Bengal and North-Western Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of—
(a) 25 BOGIE TIMBER TRUCKS, 40ft. 6in. long (without wheels and axles).
(b) 100 PAIRS of WHEELS and AXLES,
as per specifications to be seen at the Company's offices.

Tenders addressed to the undersigned, and marked "Tender for Timber Trucks," or as the case may be, are to be lodged not later than Noon on Monday, the 5th day of December, 1921.

For specification (a) a fee of £1 and (b) a fee of 10s. each will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Managing Director.

237, Gresham House,
Old Broad-street, London, E.C. 2.
8th November, 1921. 6646

The Great Indian Peninsula Railway Company.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

	Fee for Specification.
No. 1. LAMINATED SPRINGS	£1
No. 2. PIG IRON	£1

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes sealed and addressed to the undersigned, marked "Tender for Laminated Springs," or as the case may be, not later than Eleven o'clock a.m., on Tuesday, the 22nd November, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2.
London, 9th November, 1921. 6676

Wrexham and East Denbighshire Water Co.
SUPPLY OF 12in. DIAMETER STEEL TUBES.

The Directors invite TENDERS for the SUPPLY and DELIVERY of approximately 18,000ft. of 12in. STEEL TUBES, with spigot and socket ends.

Full particulars may be obtained on application to the undersigned.

Sealed Tenders, endorsed "Tenders for 12in. Steel Tubes," to be delivered at the offices of the Company, Egerton-street, Wrexham, not later than 1st December next.

The Company do not bind themselves to accept the lowest or any Tender.

FREDERICK STORR,
Engineer and Secretary.

Water Offices,
Egerton-street, Wrexham.
8th November, 1921. 6642

Wrexham and East Denbigh
SHIRE WATER CO.
12in. CAST IRON PIPES.

The Directors invite TENDERS for the SUPPLY and DELIVERY of about 800 Tons of 12in. CAST IRON PIPES and SPECIAL CASTINGS (to the British Standard Specification).

Particulars may be obtained on application to the undersigned.

Sealed Tenders, endorsed "Tenders for 12in. Cast Iron Pipes," to be delivered to the offices of the Company, Egerton-street, Wrexham, not later than 1st December next.

The Company do not bind themselves to accept the lowest or any Tender.

FREDERICK STORR,
Engineer and Secretary.

Water Offices,
Egerton-street, Wrexham.
8th November, 1921. 6641

South Staffordshire Water-Works Company.
TEMPORARY INSPECTOR OF STEEL PIPES.

The above Company REQUIRE AT ONCE the SERVICES of an INSPECTOR, to Superintend the Manufacture and Testing of 24in. and 18in. Lap-welded Steel Pipes. It is expected the contract will extend over about twelve months.

Applications, in writing, giving age, details of experience, salary required and enclosing copies of recent testimonials, must be addressed to the undersigned.

Only applications from Inspectors who have had similar experience will be considered.

FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.

26A, Paradise-street, Birmingham. 6680

PUBLIC NOTICES (continued) Page II.

SITUATIONS OPEN, Page II.

SITUATIONS WANTED, Page II.

MACHINERY, &c., WANTED Page III.

FOR SALE Pages III. and IV.

AUCTIONS, Pages IV. and XCIV.

PREMISES TO LET OR WANTED Page IV.

WORK WANTED, Page VIII.

AGENCIES, Page II.

MISCELLANEOUS, Page II.

For Advertisement Rates See Page 513, col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page XCIII.

PUBLIC NOTICES

FOR SALE, STEAM PLANT.

Brackley Corporation Water-Works.

Having ceased to use one of their wells, the Council has the following PLANT FOR DISPOSAL, all in good working order :—

TWO LANCASHIRE BOILERS, 8ft. dia. by 12ft. long, complete with steam valves and piping, check valves and feed pipes, usual fittings and dampers.

ONE STEAM RAM FEED PUMP and PIPES.

ONE W.I. FEED-WATER TANK, 3ft. by 3ft. by 3ft., with valves and piping.

TWO INDEPENDENT HORIZONTAL STEAM ENGINES, driving on one double crank shaft, one 12in. dia. cylinder by 20in. stroke, steam jacketed, with throttle governor; one 11½in. dia. cylinder by 20in. stroke, with link governor, complete with sight-feed lubricators, steam valves, piping, fly-wheel and barring tackle.

ONE 5 H.P. STEAM ENGINE, complete with governor, &c.

ONE LATHE, 9½in. centre, 11ft. 3in. bed, with gap, geared head, double traverse, and screw-cutting, complete with wheels, chuck, face-plate, guide rests, angle plates, countershaft, tools, &c.

ONE small SHAPING MACHINE, self-acting, complete with countershaft.

ONE THREE-THROW C.M. BARRELL PUMP and crank shaft.

TO BE SOLD as it stands in One Lot or in parts. Can be seen at any time by appointment.

For further particulars apply to the Waterworks Manager, Brackley, Northants.

C. E. BARNES,
Town Clerk.

Brackley, 9th November, 1921. 6679

City of Birmingham Electric SUPPLY DEPARTMENT.

STEAM-DRIVEN ELECTRIC GENERATING PLANT FOR SALE.

The undermentioned PLANT, installed at the Corporation Electric Generating Station, Chester-street, Aston, Birmingham, is FOR SALE and IMMEDIATE REMOVAL :—

ONE 750 K.W. GENERATING SET, comprising a Yates and Thom Vertical Cross-compound Engine, with cylinders 25in. and 50in. diameter, 3ft. 6in. stroke, 95 revs. per minute, 150 lb. per square inch steam pressure direct coupled to a General Electric Co.'s multi-polar compound-wound direct-current Generator, 440-550 volts. The engine is complete with a Worthington surface condenser, air pump and circulating water pump.

The plant, which was installed in 1906, is in first-class condition and can be inspected or seen on load by appointment.

Permits to inspect and conditions of sale can be obtained on application to the undersigned, to whom all offers should be addressed :—

E. J. JENNINGS,
Secretary.

14, Dale-end, Birmingham,
8th November 1921.

Bombay Port Trust.

The Trustees invite APPLICATIONS from Engineers possessing experience in Port, Dock, and Railway Construction and Maintenance for APPOINTMENT as their CHIEF ENGINEER.

The salary of the officer selected will be determined according to qualifications and experience.

Under the Trustees' rules married officers are provided with house accommodation, for which rent at the rate of 10 per cent. of salary is charged.

Applications should be addressed in writing to the Consulting Engineers and Agents, Bombay Port Trust, 2, Queen Anne's-gate, S.W., and will be received up to 1st December, 1921. They should be accompanied by a complete resume of applicant's professional career and copies of not more than three recent testimonials.

Age (preferably between 40 and 45 years) should be stated.

By Order of the Trustees,
A. J. BARRY,
WALTER C. HUGHES,
K. A. WOLFE BARRY,
Consulting Engineers and Agents.

28th October, 1921.
Dartmouth House,
2, Queen Anne's-gate,
Westminster, London. 6570

Islington Institution, St. John's-ROAD, UPPER HOLLOWAY, N. 19.

WORKING ENGINEER.

WORKING ENGINEER REQUIRED at the above Institution for the Upkeep and Maintenance of Plant, &c.

Candidates, who must not be more than 45 years of age, must have a practical and theoretical knowledge of Boilers of the Lancashire type, and of all machinery appertaining to the Heating, Cooking, and Laundry arrangements of a large institution, and must be practical repairers and fitters.

The Guardians contemplate the installation of electric lighting, and applicants must be fully experienced and able to deal with this branch of work.

A knowledge of motor car repairing will be an advantage.

Salary £6 per week, rising after 12 months' approved service to £6 6s., subject to deduction under the National Health and Superannuation Acts.

Apply for forms of application to the MASTER of the INSTITUTION, as above, enclosing stamped addressed foolscap envelope.

Completed forms to be returned not later than the 21st November. 6689

The Warneford, Leamington, and South Warwickshire General Hospital.

REQUIRE the SERVICES of a competent ENGINEER to Take Charge of Boilers, Heating and Domestic Hot Water Supply, Water-softening Plant, Lifts and other Mechanical and Electrical Apparatus in connection with the Institution. The person appointed would be responsible for the efficient upkeep and all running repairs. Applications, enclosing copies of recent testimonials, stating wages required, age and date able to start, to be sent to—

THE HOUSE GOVERNOR,
6623 Warneford Hospital, Leamington.

Wilts County Council.

LAND DRAINAGE COMMITTEE.

ASSISTANT DRAINAGE ENGINEERING SURVEYOR REQUIRED for the Preparation of Land Drainage Schemes for the alleviation of unemployment. The schemes will provide for the improvement of the main rivers of the county.

The person appointed should be able to carry out Referencing Work, Take Levels, Prepare Plans, Longitudinal and Cross Sections, and assist in the general supervision and management of labour.

Preference given to an ex-Service R.E.

The appointment is of a temporary nature subject to one month's notice. Salary £5 per week.

Applications (not later than the 15th inst.), together with copies of three recent testimonials, to WHITFIELD, County Drainage Surveyor, Polebarn House, Trowbridge, Wilts. 6644

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.
46, Watling Street, London, E.C. 4.

Established seventy years.

PUPILS' DINNER.

THE PAST and PRESENT PUPILS of Messrs. VICKERS, Erith, will hold their ANNUAL DINNER at the "Florence" Restaurant, Rupert-street, W., on the 10th DECEMBER. Tickets 10s. 6d. each. Those wishing to attend, please communicate with J. A. L. SCRIBANTE, 28, Church-rd., Erith, Kent.

SITUATIONS OPEN

WANTED, HEAD ENGINEER for Large Gelatine Works, capable of planning all details of re-arrangement of plant and with a thorough knowledge of steam and electrical matters. Liberal encouragement to thoroughly capable man.—Address, with copy of testimonials and particulars, P4338, The Engineer Office. P4338 A

A YOUNG ENGINEER, with a Sound Knowledge of Design of Air Compressors, to Take Charge of a Small Department and work same up under his own control. This represents an excellent opening to a qualified man.—Address, 6563, The Engineer Office. 6563 A

COLLIERY SUPERINTENDENT ENGINEER REQUIRED for large Australian Collieries, to work under General Manager. Must be thoroughly experienced in both Steam and Electrical Plants as applied modern collieries. Experienced with Coking and By-product Plants an advantage. Only first-class men will be considered.—Address applications and references in duplicate, stating experience, salary expected, age and when at liberty, furnishing photo., 6667, The Engineer Office. 6667 A

ENGINEER FOR CEMENT WORKS.—WANTED, a CONSTRUCTIONAL and OPERATING ENGINEER in India, to Superintend Erection and Maintenance of Cement Mill Machinery, Rotary Kilns, and Power Plants. Salary offered up to Rs. 900 per month, according to qualifications, with free quarters, light and fuel. Three years' agreement with first-class passage out and home. Good prospects for suitable man.—Apply by letter only, with copies of testimonials, &c., to TATA, Limited, Capel House, New Broad-street, London, E.C. 2. 6338 A

REQUIRED, ENGINEER'S TRAVELLER. Fully conversant with Steam Pumps; one with home and colonial connection. Write fully experience and salary required.—Address, 6661, The Engineer Office. 6661 A

REQUIRED, MANAGER for Modern Portland Cement Works in the East. Output 50,000 tons per annum with vertical kilns. Previous experience as Manager essential. Preferably under 45 and unmarried.—Apply by letter, stating qualifications and full particulars of previous appointments, to 6672, The Engineer Office. 6672 A

VIEWER and PROGRESS MAN for Manufacturing Process, calling for extreme accuracy, for works situated in Northamptonshire.—Write, stating age, experience, and salary required, WILLIAMS, c/o Hadden's Advertising Offices, Salisbury-square, E.C. 4. 6626 A

YOUNG PROGRESSIVE ENGINEER REQUIRED for London. Good address and experienced in salesmanship. General knowledge of Chemical, Tin-plating and Galvanising, Cellulose, &c., industries essential. Public schoolboy, disabled, but active ex-officer preferred. Some knowledge of German desirable. Salary £450 to £600, according to qualifications. State briefly details of education, training, and subsequent experiences, age, and three references.—Address, P4342, The Engineer Office. P4342 A

TECHNICAL and COMMERCIAL ASSISTANT, with ultimate promotion, for department handling a specialty in non-corrodible metals. Good opportunity and prospects for energetic technically trained man. State experience and give references.—Address, "TECHNICAL," Wm. Porteous and Co., Advertising Agents, Glasgow. P4561 A

WOODWORKING MACHINERY.—TRAVELLER REQUIRED, with experience in Woodworking Machines. State references and terms.—Address, P4570, The Engineer Office. P4570 A

CHIEF DRAUGHTSMAN WANTED for Engineering Works in Wolverhampton District; good experience in Pumping Installation and General Steam Engine Work essential.—Address, stating experience and salary required, P4339, The Engineer Office. P4339 A

DRAUGHTSMAN.—REQUIRED for London Office of Firm of Constructional Engineers, CHIEF DRAUGHTSMAN with first-class experience in preparing competitive designs for Steel-framed Structures, Sheds, Light Bridges, &c. Applications, which will be treated in strict confidence, should contain full particulars of applicant's experience, the names of firms with whom gained, nature of present employment, and salary anticipated.—Address, P4345, The Engineer Office. P4345 A

DRAUGHTSMAN REQUIRED, North-East Coast, for Structural Work and Bridge Work. Only fully experienced men need apply. Applications from juniors and improvers will not be considered. State salary required.—Address, 6541, The Engineer Office. 6541 A

DRAUGHTSMAN WANTED for the Design of Small Mechanical and Electrical Apparatus. Must have good experience for original work. London district.—Address, stating full particulars, 6654, The Engineer Office. 6654 A

FOUNDRY FOREMAN WANTED in Small but Well-established General Engineer's Foundry in South London. Must be thoroughly experienced in Green, Dry Sand, and Loam Castings, good manager of men, and able to take entire control. Present output averages 10 tons per week, but extensions now in progress should result in much larger output. Existing plant enables castings to be made up to 5 tons.

Good opportunity for a thoroughly competent man combining character and energy. State age, experience, and salary expected.

Address in first instance, P4344, The Engineer Office. P4344 A

PUMP FITTER REQUIRED for Gold Mine, West Africa, to Take Charge and Maintain Underground Pumps, electrical and air-driven; previous experience essential. State age, qualifications and references.—Address, 6673, The Engineer Office. 6673 A

SITUATIONS WANTED

ADVERTISER, with A1 Experience in Latest methods of production, tool-room, machine shop and die casting, DESIRES POSITION as FOREMAN with go-ahead firm. Not afraid to take off coat and do a bit. Age 36.—Address, P4358, The Engineer Office. P4358 B

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT. Services available for New Year or possibly before.—Write, Z. M., 613, c/o Deacon's, Leadenhall-street, E.C. 3. 6665 B

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For continuation of Small Advertisements see page iii

Recent Locomotive Practice on the Caledonian Railway.

No. II.*

By E. C. POULTNEY.

Four-coupled Engines.

The engraving of the 4–4–0 engine given on page 501 shows one of ten of these locomotives recently built at St. Rollox. Prior to the building of these last ten engines, there were in service sixteen similar engines, six of which were built at St. Rollox and ten by the North British Locomotive Company, Limited, from Mr. Pickersgill's designs and specifications. The total number in traffic is now twenty-six. The first sixteen engines had 20in. cylinders, but the last ten built at St. Rollox have 20½in. cylinders, as have also a further ten now being built by Sir W. G. Armstrong, Whitworth and Co., Limited. The bogie wheels are 3ft. 6in. diameter and are spaced 7ft. between centres. The boiler has a mean outside diameter of 4ft. 10½in. and the barrel section is 11ft. 2in. long. There are 157 steel tubes, 1¾in. outside diameter, and twenty-four 5in. tubes. The length between the tube plates is 11ft. 6in. The boilers are fitted with a superheater of the Robinson type having twenty-four elements. The superheater tubes are 1¾in. outside diameter. Two Ross pop safety valves are fitted, adjusted for a working steam pressure of 180 lb. per square inch.

The cylinders are placed 2ft. 1½in. between centres and have piston valves of the trick pattern, giving inside admission, working in valve chests on the top of the cylinders. The ordinary link motion is used, which drives the valves through rockers. The rockers are carried by brackets fixed to the motion plate which supports the slide bars, and there is also a built-up cross stay behind the motion plate, from which are suspended the hangers which carry the connecting links between the link blocks and the lower arms of the rockers. The slide bars are of the box type, which has been a feature of Caledonian practice for many years. The connecting-rods are 7ft. 1in. long between centres, and the big ends are of the so-called marine type. Built-up crank axles are used in these engines. The motion generally is very substantially designed and appears to have ample bearing surfaces. The coupled wheels are spaced 9ft. 9in. between centres, and the weight on the driving wheels is taken by two coil springs for each axle-box, that on the trailing wheels being taken by ordinary laminated springs. In the matter of materials used for the various parts and in general design, these engines follow closely the practice adopted in the 4–6–0 type engines. The force feed lubricator is fixed on the running plate. It is worked by an auxiliary crank on the coupling pin of the driving axle. The engines have the automatic air valve mentioned when describing the 4–6–0 locomotives in the previous article, and they also have dampers which may be worked by a handle placed on the right side of the cab. In practice, however, the dampers are always left open, and, I believe, in future they will be omitted. The cylinders are fitted with the by-pass valves described in the first article, and also with combined drain cocks and spring-loaded pressure release valves. Steam sanding gear is also fitted. The brake gear on the engine and tender is the Westinghouse, and an ejector is also provided for working trains equipped only with the automatic vacuum brake.

The Six-coupled Goods Engine.

The six-coupled goods engine, which is also shown in an engraving on page 501, does not call for much attention. It is a simple straightforward design, which has been built to handle loads which experience has proved to be convenient, having regard to the traffic conditions and the physical characteristics of the line.

At first thought it might be considered that an eight-coupled engine might have offered advantages in dealing with the heavy traffic met with on the Caledonian system, but though it is true that eight-coupled engines are in service, it has been found that an engine of the class shown having wheels of medium diameter can haul trains of a weight best adapted to the road, and give greater satisfaction than would the much larger engines which are in successful operation on other lines. Mr. Pickersgill has given this subject a good deal of thought, one difficulty being that, as the Caledonian main line consists of just the two sets of rails, the "up" and "down" roads respectively, and as some of the refuge sidings are situated a long distance apart, while some are comparatively close together, it is necessary to haul a moderate load at a reasonably high speed and get it through with little or no shunting to make way for other trains, rather than to haul a heavier train at a lower average speed and shunt to enable fast trains to pass.

These goods engines have 5ft. driving wheels and the inside cylinders are 18½in. by 26in. The steam distribution is effected by semi-balanced slide valves actuated by the ordinary type of link motion through the medium of rockers. The drawing, Fig. 6, shows this slide valve, the features of which are the balancing piston let into the back and the design of the supporting spring which holds the piston up against a machined face on the under side of the valve chest cover. The valve is of gun-metal, the balancing piston of cast iron, and its packing ring of gun-metal, the spring being steel. The design is particularly neat and substantial. It will be noticed that this engine has a force feed lubricator operated by a return crank on the main coupling rod pin. The usual type of solid forged crank axle is used. The motion in general follows St. Rollox standards and comprises box pattern slide bars and the marine type big ends as in the four-coupled express locomotives. The boiler is not fitted with a superheater. The number of tubes is 275; they are 1¾in. outside diameter, and the length between the tube plates is 10ft. 7in. The mean diameter of the boiler barrel is 4ft. 8¾in. and its centre is 8ft. 3in. from the rail. The working steam pressure is 170 lb. per square inch. The tender is smaller than those used for the passenger engines. The tank capacity is 3000 gals. and 4½ tons of coal can be carried when loaded flush with the coping. A steam brake operates on the engine and tender. There are twelve of these engines in service and they were all built at St. Rollox.

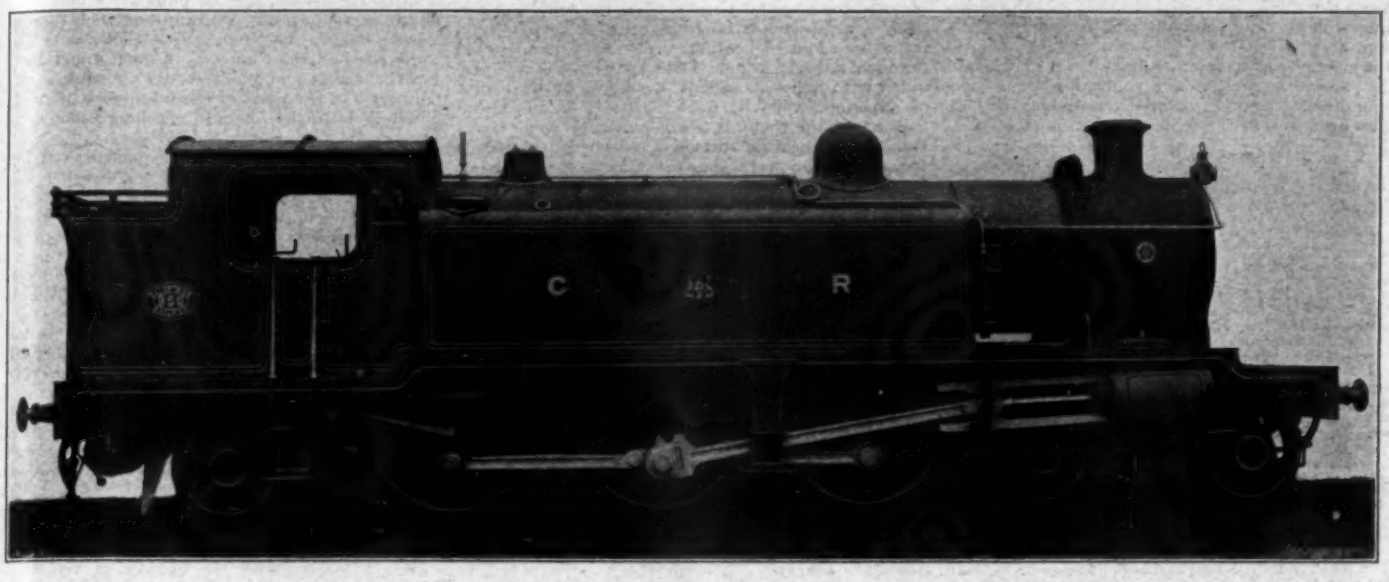


FIG. 5—4-6-2 TYPE PASSENGER TANK ENGINE

Tank Engine.

For working heavy local passenger trains in the Glasgow district, also on the main line, and for pusher services on the Beattock Bank, a powerful six-coupled tank engine has been designed. These engines have been built by the North British Locomotive Company of Glasgow, from drawings and specifications prepared at St. Rollox. One of them is shown in Fig. 5.

The outside cylinders are 19½in. by 26in., and they and the motion are practically identical with those used in the six-coupled passenger engines. The bogie is also standard with those used on the express engines. The bunker is carried by a radial axle, the wheels of which, like those of the leading bogie, are 3ft. 6in. diameter. The coupled wheels are 5ft. 9in. diameter. Piston valves operated direct by link motion and similar in design and construction to those adopted for the 4–6–0 and 4–4–0 passenger engines are employed. The excentrics are on the driving axle, the connecting link being formed to clear the leading coupled axle. The standard form of steam reversing gear is used, and steam sanders are fitted for forward and backwards running.

The Westinghouse brake is used, and a hand brake is

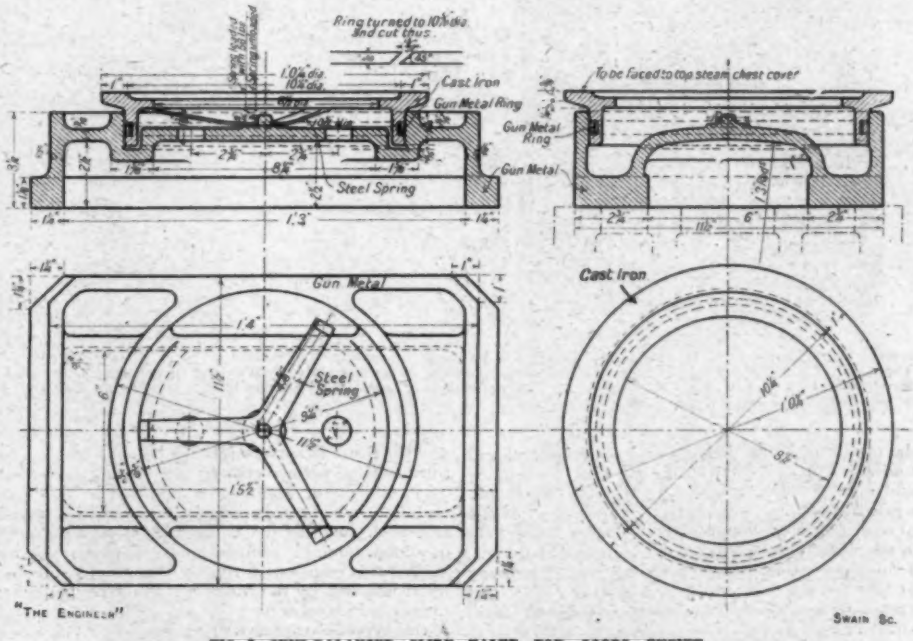


FIG. 6—SEMI-BALANCED SLIDE VALVE FOR GOODS ENGINE

* No. I. appeared November 4th.

also fitted, as is also an ejector for working the vacuum brake when required. The boiler is of good size, having a mean outside diameter of 4ft. 8¼in. There are 159 1¾in. outside diameter steel tubes and eighteen 5in. tubes, and the length between the tube plates is 14ft. 6in. It has a Robinson superheater of eighteen elements, which are 1¾in. diameter outside. Two Ross safety valves are fitted, and they are pressed to pop at 170 lb. per square inch.

An automatic air valve shown just behind the chimney is fitted and dampers are not used. By-pass valves are fitted to the cylinders. The tank capacity is 1800 gals. and the bunker has space for 3 tons of coal.

The tires are held by shrinkage and, in addition, Jeffrey's rings are used, as in the six-coupled express engines. This is the standard practice on the Caledonian, and the tires of all modern engines are held in this manner, the system holding good for bogie and tender wheels as well as for coupled wheels. The leading dimensions and principal proportions of these engines are given in the table of dimensions.

General Remarks.

The 4–6–0 type engine follows closely usual practice of the 4–4–0 engines should furnish more steam per square foot of heating surface, or, in other words, steam more freely than the 4–6–0 locomotives. This characteristic should make up for the greater power demand on the heating surfaces and grate. The adhesive factor is low, and I may say that whenever I have seen these engines starting with anything like a load the steam sanders have always been in operation. The characteristics of the boiler fitted to the 0–6–0 goods engine follow those of that fitted to the 4–4–0 passenger locomotives, though the heating surface is more liberal in proportion to the maximum tractive power. The grate surface factor is rather large; but, on the other hand, the ratio of proportion between the grate area and the heating surface is low, so that here again a fairly high rate of evaporation per square foot of heating surface may be expected for equal rates of firing. The tank engine is well provided with adhesive weight, as shown by the factor of adhesion, which is 6.28. This is an important feature where there is much starting with heavy trains. The heating surface allowance in proportion to the tractive power is the same as in the 4–6–0 engine. The grate is smaller relatively to the heating surface,

Principal Dimensions and Proportions of Caledonian Locomotives.

	4–6–0	4–4–0	0–6–0	4–6–2
Type	4–6–0	4–4–0	0–6–0	4–6–2
Class	62	77	673	950
Service	Passenger	Passenger	Goods	Local passenger
Cylinders—Number	2	2	2	2
Diameter and stroke	20in. by 26in.	20½in. by 26in.	18½in. by 26in.	19½in. by 26in.
Distance, centre to centre	6ft. 9½in.	2ft. 1½in.	2ft. 1½in.	6ft. 9½in
Valves	Piston	Piston	Balanced slide	Piston
Valve gear	Stephenson	Stephenson	Stephenson	Stephenson
Connecting-rods, length	11ft.	7ft. 1in.	6ft. 6in.	10ft. 6in.
Tractive power	21,155 lb.	21,432 lb.	21,430 lb.	19,486 lb.
Wheels—Driving and coupled wheels, diameter	6ft. 1in.	6ft. 6in.	5ft.	5ft. 9in.
Bogie, diameter	3ft. 6in.	3ft. 6in.	—	3ft. 6in.
Radial, diameter	—	—	—	3ft. 6in.
Wheel base—Centre of bogie to centre of driving axle	16ft. 7in.	11ft. 2in.	—	16ft. 0½in.
Centre of leading to centre of driving axle	7ft. 0in.	—	7ft. 9in.	6ft. 7½in.
Centre to centre bogie wheels	7ft. 0in.	7ft. 0in.	—	7ft. 0in.
Centre of driving to centre of trailing axle	7ft. 6in.	9ft. 9in	9ft. 0in.	6ft. 7½in.
Centre of trailing to centre of radial axle	—	—	—	7ft. 0in.
Total wheel base, engine	27ft. 6in.	24ft. 4in.	16ft. 9in.	33ft. 1in.
Total wheel base, engine and tender	52ft. 5½in.	46ft. 8½in.	38ft. 7½in.	—
Total length over buffers	62ft. 0in.	56ft. 2in.	51ft. 9in.	43ft. 2½in.
Boiler and fire-box—Diameter of barrel, mean, outside	5ft. 2½in.	4ft. 10½in.	4ft. 8½in.	4ft. 8½in.
Length of barrel	15ft. 9in.	11ft. 2in.	10ft. 3½in.	14ft. 1 1in.
Height to centre from rail	8ft. 6in.	8ft. 3in.	8ft. 3in.	8ft. 3in.
Steam pressure	175	180	170	170
Tubes—Material	Steel	Steel	Steel	Steel
Number, small	130	157	275	159
,, large	24	24	—	18
Diameter outside, small	2in.	1¾in.	1¾in.	1¾in.
,, ,, large	5in.	5in.	—	5in.
Length between tube plates	15ft. 3in.	11ft. 6in.	10ft. 7in.	14ft. 7in.
Heating surfaces—Tubes, small	1038.0 sq. ft.	827 sq. ft.	1332.92 sq. ft.	1056 sq. ft.
,, large	491.5 ,,	358 ,,	—	339 ,,
Fire-box	146.5 ,,	144 ,,	118.78 ,,	121 ,,
Total	1676.0 ,,	1329 ,,	1451.7 ,,	1516 ,,
Superheater	258.25 ,,	200 ,,	—	200 ,,
Total equivalent	2063.42 ,,	1629 ,,	—	1816 ,,
Grate area	25.5 ,,	20.7 ,,	20.0 ,,	21.5 ,,
Weights—On bogie	18 tons 10 cwt.	21 tons 10 cwt.	—	21 tons 0 cwt.
,, leading axle	18 ,, 0 ,,	—	17 tons 13 cwt.	18 ,, 5 ,,
,, driving axle	19 ,, 5 ,,	19 ,, 18 ,,	18 ,, 2 ,,	18 ,, 7 ,,
,, trailing axle	19 ,, 5 ,,	19 ,, 17 ,,	13 ,, 10 ,,	18 ,, 9 ,,
,, radial axle	—	—	—	15 ,, 12 ,,
Total weight, engine	75 ,, 0 ,,	61 ,, 5 ,,	49 ,, 5 ,,	91 ,, 13 ,,
Tender—Wheels, diameter	4ft.	4ft.	4ft.	—
Wheel base	13ft.	13ft.	13ft.	—
Capacity of tanks	4200 galls.	4200 galls.	3000 galls.	1800 galls.
Coal capacity	6 tons 0 cwt.	6 tons 0 cwt.	4 tons 0 cwt.	3 tons 0 cwt.
Weight loaded	46 ,, 10 ,,	46 ,, 10 ,,	37 ,, 5 ,,	—
Total weight, engine and tender in working order	121 ,, 10 ,,	109 ,, 0 ,,	86 ,, 10 ,,	—
Ratios—				
Weight on coupled axles / Tractive power	6.02	4.16	5.14	6.28
Total engine weight / Equivalent heating surface	86.0	84.0	76.0*	112.9
Tractive power × diameter of drivers / Equivalent heating surface	743	1028	885*	740
Tractive power / Grate area	825	1036	1072	906
†Fire-box surface / Equivalent heating surface	7.08	8.85	8.10*	6.6
Equivalent heating surface / Grate area	81.0	78.6	72.5	84.4

Equivalent heating surface = Total evaporating surface + 1½ times the superheating surface.

* These figures are obtained by using the total evaporative heating surfaces as the engines are not superheated.

† Fire-box heating surface as a percentage of the total equivalent or total actual heating surface for superheated and non-superheated engines respectively.

in the matter of boiler demand and grate factors, and the adhesive factor of 6.02 shows that the engine should not be much troubled by slipping. The fire-box heating surface is equal to 7.08 per cent. of the total equivalent, a figure which compares favourably with the usual practice in engines of the 4–6–0 type, and this figure, together with the ratio of proportion of 81 between the total equivalent heating surface and the grate area, indicates that the boilers should steam readily. Trials made between Glasgow and Perth in regular passenger service show that these engines can haul 370 tons at 42 miles per hour and maintain from 900 to 1000 indicated horse-power. The total equivalent heating surface is 2063 square feet, so that when developing 1000 indicated horse-power 2.06 square feet of heating surface are sufficient per indicated horse-power, which may be considered a satisfactory performance.

The 4–4–0 engines have rather high boiler demand and grate factors, though in this connection the fire-box is seen to furnish a higher percentage of the total equivalent heating surface than in the case of the 4–6–0 engines, and the grate is also rather larger in proportion to the total heating surface. From this it will be realised that for equal rates of firing the boilers and the fire-box surface forms a less percentage of the total heating surface than in any of the other engines. The grate factor, though perhaps a little high, is not unduly so when compared with usual British practice, and this, together with the liberal heating surface provided, should ensure good steaming capacity. With tank engines, owing to the weight difficulties often imposed by the tanks, it is not easy to provide liberal boiler capacity; on the other hand, engines of this type have not as a rule to maintain a high power output for sustained periods, owing to the more or less intermittent character of the work on which they are employed; therefore considerable boiler power, although always an advantage, is not necessary.

I think designers who appreciate symmetrical appearance will agree that Caledonian locomotives have in the past been always pleasing in this respect, and I believe it will be generally conceded that Mr. Pickersgill's new engines fully maintain the reputation thus established by previous locomotives designed and built at St. Rollox.

The president for the year 1922 of the Permanent Way Institution is Mr. A. W. Szlumper, the chief engineer of the London and South-Western Railway.

Institution of Mechanical Engineers

POWER TRANSMISSION BY OIL.

The Institution of Mechanical Engineers met at Storey's Gate on Friday, November 4th, to hear the Thomas Hawksley lecture, which was given by Dr. H. S. Hele-Shaw, F.R.S., who took "Power Transmission by Oil" as his subject.

He emphasised the importance of his subject by saying that the transmission and transformation of power was the basis of engineering. One method of transmitting power was by pumping a fluid into one end of a conduit and utilising it at the other end to drive a motor. For such purposes oil was by far and away the best fluid known. A good mineral oil was inactive chemically, and thus did not cause corrosion, it lubricated the parts of the machinery, its viscosity could be utilised to help in checking leakage, and it was practically incompressible.

With the assistance of some models and lantern slides the principal features of the swash plate and the excentric types of variable-stroke pump were then explained, but the designs of these machines are too well known to readers of The Engineer for it to be necessary to enlarge upon the subject here. The great advance in the efficiency of the excentric machine which was effected by mounting the cylinder casting on bearings and rotating it round the shaft is, however, worthy of emphasis, and in this connection the lecturer pointed out that although the pistons had a reciprocating stroke with regard to the cylinders, almost perfect balance was obtained, as both the moving systems had a pure rotary motion. It was impracticable in these pumps to use such devices as cup leathers to keep the pistons tight in the cylinders, and consequently plain grooves were adopted. The viscosity of the oil was such that it had not sufficient time to leak past the grooves before the pressure was reversed and the leakage sucked back again.

When dealing with the subject of viscosity the lecturer introduced the theory of the Michel bearing, and showed, by lantern slides of stream lines, how some of the oil which entered between the two sloping faces of the bearing escaped at the sides while the remainder was dragged on into the narrowest space between the two surfaces. There the film of oil became so thin that its viscosity prevented it from flowing away freely, and it accumulated until very high pressures were attained. The area of the bearing which actually supported the load was thus quite small. After exhibiting several slides in illustration of this phenomenon, Dr. Hele-Shaw admitted that some of them really showed the magnetic lines of force in a toothed armature stamping, but said that they were similar in their formation to the stream lines in the bearing.

On the lecture table there was arranged a projector with a small glass tank in front of the condenser. The tank was partly filled with oil, and could be plainly seen on the screen. The lecturer pumped some of the oil into and out of the tank, by means of a small hand pump, and showed how the character of the oil was unaffected so long as the pump delivery was kept below the surface, but as soon as the outlet was uncovered air bubbles were entrained and the oil quickly became frothy. It was thus necessary, when using oil for the transmission of power, to be sure that the oil delivery was kept below the surface, otherwise the incompressible nature of the liquid was destroyed.

From this point onwards the lecture was concerned almost entirely with the physics of lubrication, and several experiments were made and projected on to the screen by means of the lantern to demonstrate the various points raised. In one of these experiments, which was intended to demonstrate the rolling action of the particles of oil in lubricating two surfaces, a drop of coloured oil was put on a glass plate and another plate put upon the top of it. The drop immediately spread out into a thin film in the form of a true circle, and when the upper plate was moved the disc of oil moved also, but it was quite plain to see that the oil moved only half as fast as the plate, showing that the plate was rolling on the oil. In the next experiment the top plate was rubbed about until the oil was gradually squeezed out, and finally, when the film of oil had been reduced to molecular dimensions, the two plates seized together. The same effect was obtained by adding some water to the oil, but the seizing was produced much more readily, as the water quickly displaced a large proportion of the oil. Water was, nevertheless, said Dr. Hele-Shaw, the better lubricant of the two—if it could be kept between the two surfaces. Another experiment had been arranged to demonstrate the stream lines of the oil passing through a Michel bearing, but unfortunately some paper packing between the glass plates had swollen during the course of the lecture and choked the flow of oil.

The lecture was concluded by the exhibition of a long series of slides depicting the application of oil power transmission to a number of services, including road traction, but for this purpose the lecturer said it could not compete with the orthodox gear-box, on account of its capital cost, although it was undoubtedly a much nicer arrangement.

TWO RECENT CALEDONIAN LOCOMOTIVES

MR. W. PICKERSGILL, ST. ROLLOX, ENGINEER

(*For description see page 499*)

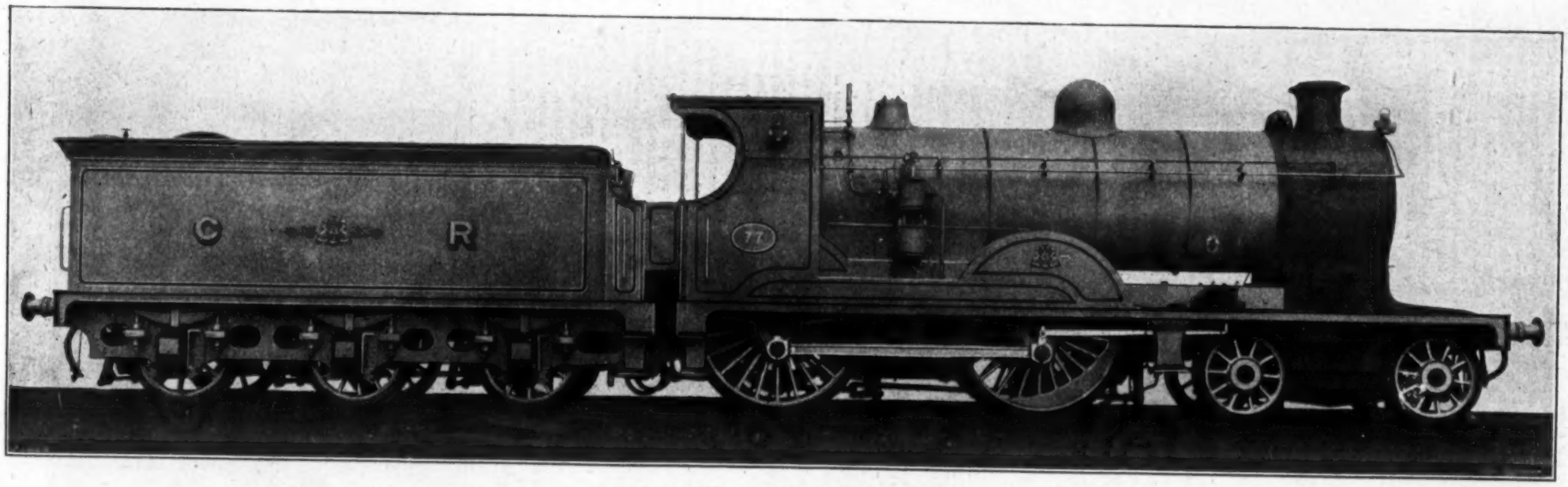


FIG. 7—4-4-0 TYPE EXPRESS PASSENGER ENGINE

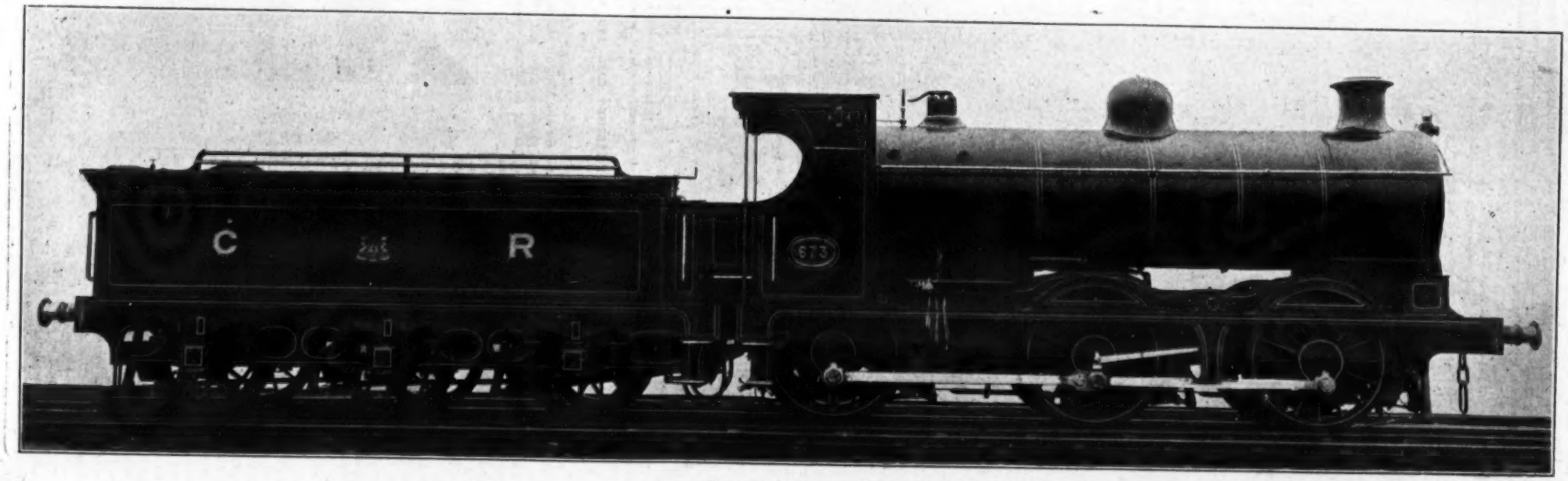


FIG. 8—0-6-0 TYPE GOODS ENGINE

Developments in Power Station Design.

No. XV.*

RECOGNISING that in some cases at any rate pulverised fuel offers certain advantages, the Underfeed Stoker Company, of London, has made arrangements with the Combustion Engineering Corporation, of New York, to utilise the Lopulco system, as employed, for example, for firing the exceptionally large boilers connected with the River Rouge plant belonging to the Ford Motor Company. The views of the Underfeed Stoker Company's engineers may prove of interest. It is obvious, they explain, that as combustion is a result of the chemical combination of combustible matter with oxygen, if the matter be reduced to the finest possible state of subdivision, the chemical union will be facilitated and will be made instantaneous and complete; but unfortunately the pulverisation of coal involves the expenditure of energy. A point which is considered to be of importance, however, is that the system presents the possibility of eliminating the human element. The most perfect form of mechanical stoker, it is pointed out, will work inefficiently if the fireman fails to keep the grate covered with fuel, or fails to adjust the thickness of the fuel bed and the rate of travel of the grate so as to ensure the minimum loss of combustible matter with the ashes. With the pulverised system, the preparation of the fuel for combustion is purely mechanical, and the proportions of coal and air may be regulated with the same ease as the air and fuel of an internal combustion engine. Valves controlling the admission of the combustible mixture may readily be operated indirectly by the steam pressure, so as to ensure automatic regulation to meet the variable demands for steam.

To counterbalance the cost of the power used for pulverising the coal and to justify the adoption of the system, it must, in the opinion of the engineers of the Underfeed Stoker Company, be possible to secure the following advantages in a sufficient degree to establish a balance in its favour:—(1) A reduction in the percentage of the combustible matter lost with the ashes; (2) a higher percentage of CO_2 in the products of combustion; (3) a saving of labour; and (4) a greater uniformity of the efficiency due to the elimination of the human element. Many tests have been made in connection with pulverised fuel in order to determine to what extent the above advantages could be realised. Some time ago the Combustion Engineering Corporation, of New York, arranged with Mr. Kreisinger, combustion expert and investigator for the Bureau of Mines, to conduct a series of investigations extending over a period of many months, in order to obtain data in addition to that which had already been collected. One of the matters to which particular attention was paid was the cost of crushing the coal. Hitherto, it has been assumed that to obtain the best results the coal should be crushed so that 85 per cent. will pass through a screen having 200 holes to the square inch, but Mr. Kreisinger has found that if the coal is crushed so that 60 per cent. of it will pass through a 200-mesh screen, a high efficiency of combustion can still be maintained, whilst the cost of crushing is reduced. It is known that when burning pulverised fuel a very high percentage of CO_2 can be obtained, without the production of any CO, but it has been found that with a high percentage of CO_2 the furnace temperature is so great that the best refractory material fails to withstand the temperature, and it has been necessary to maintain a lower percentage of CO_2, and consequently a lower furnace temperature. For this reason, it is explained, one of the advantages to be derived from pulverised fuel cannot at present be obtained, but it is expected that with further experience in the application of burners and in the design of combustion chambers, a high percentage of CO_2 will be practicable.

It has been clearly demonstrated that with the combustion of powdered fuel the loss of combustible matter with the ashes is reduced to a negligible quantity, and with certain coals containing a high percentage of ash the saving resulting from this is sufficient to counterbalance the cost of pulverisation. It is considered extremely doubtful whether on the plants already in operation there has been any reduction in the labour costs as compared with those of the mechanical stoker system, but it is considered that a saving in this direction will eventually be secured. It became evident when the initial experiments with pulverised fuel were made that large combustion chambers would be necessary in order to preserve the refractory material and ensure the separation of the ashes in a form permitting their ready removal. In a small combustion chamber the powdered coal is projected into the furnace at a high velocity, and the fuel, together with the air needed for combustion, strikes the furnace walls in such a way as to cause the rapid fluxing and melting away of the brickwork, but it is claimed that with the Lopulco system, which embodies improved means of introducing the fuel into the furnace, it is possible to work with a higher rate of combustion per cubic foot of combustion space than is permissible with any other system.

The fuel is introduced into the furnace in a vertical downward direction, and the products of combustion are compelled to reverse their direction before reaching the limits of the combustion chamber, so that the flame has to travel the maximum path before it reaches the heating surface and before it comes into contact with any of the refractory material lining the furnace. Tests have shown that with this system the fuel may be burnt without involving damage to the brickwork, and with the precipitation of ash in a form which can be readily handled at a rate of 1¼ lb. per cubic foot of combustion space. When coal is burnt on a mechanical grate, it has been found possible to ensure good combustion and durability of brickwork with a relatively small combustion space per pound of coal, and it is obvious that if with powdered coal all the combustion space available be uniformly utilised, it is not necessary to have a larger combustion chamber for powdered coal than that needed with mechanical stokers. With the same amount of coal burnt in each case and with the same percentage of CO_2, the volume of gas would be the same, and the temperature would also be equal. Moreover, if the whole of the combustion chamber were properly utilised, the velocity should also be equal, but with the present burners this is impracticable. The coal is projected into the combustion chamber from a number of burners spaced some distance apart, in high-velocity streams, so that there is a wide variation in the velocity of the gases in different parts of the same combustion chamber. The whole area of

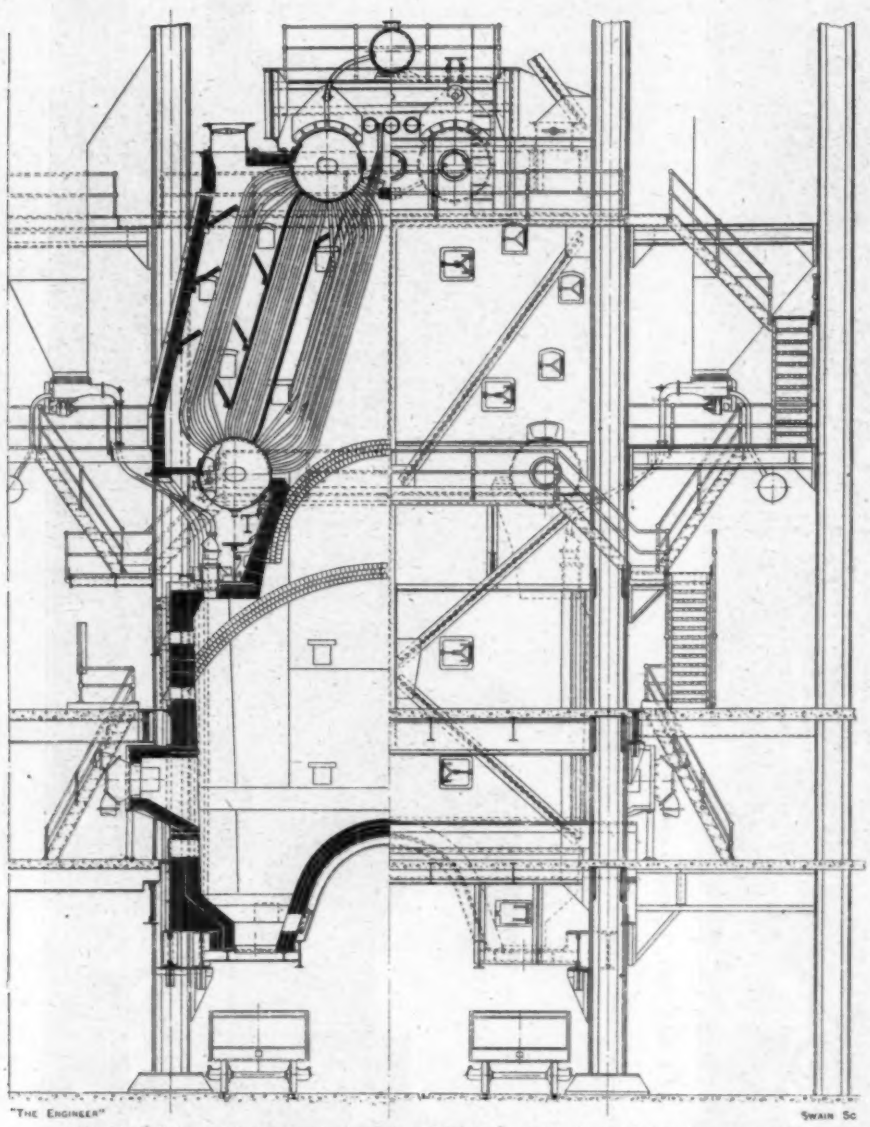


FIG. 72—2640-H.P. BOILER FITTED FOR PULVERISED COAL AND BLAST FURNACE GAS

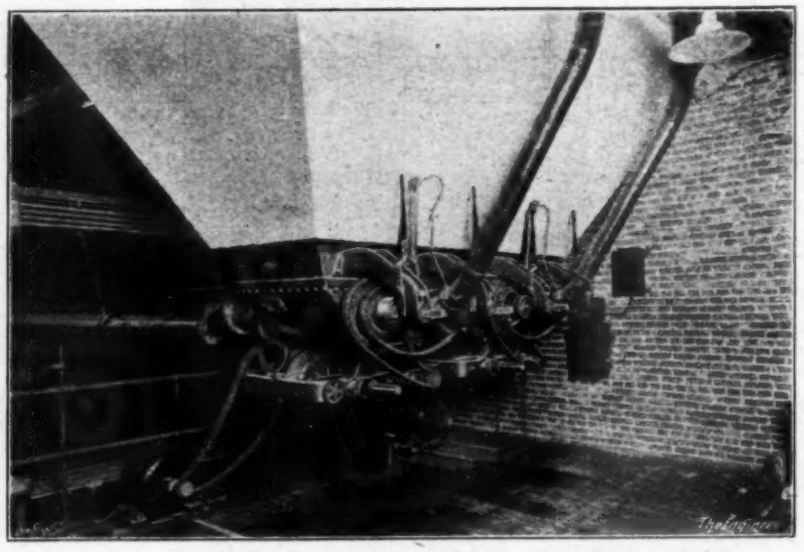


FIG. 73—LOPULCO PULVERISED COAL FEEDERS

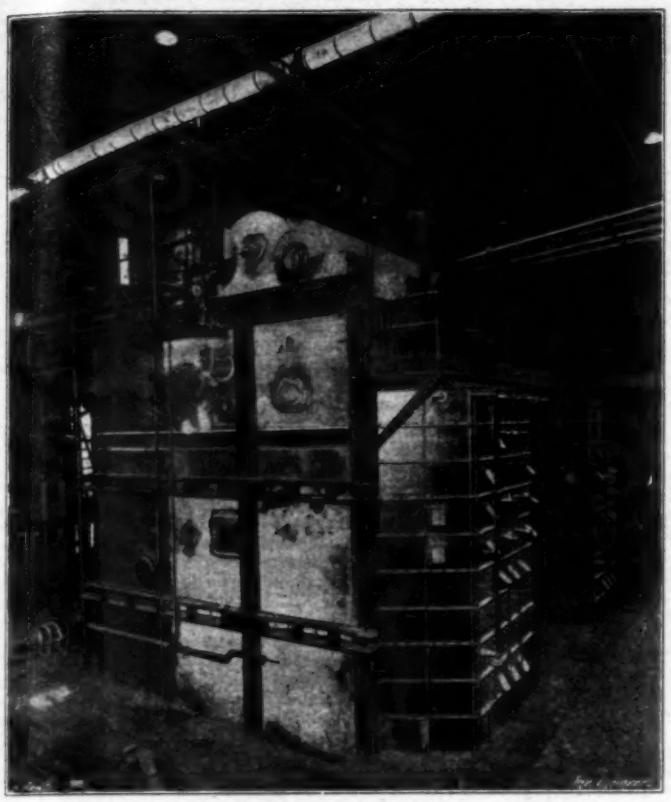
* No. XIV. appeared October 28th.

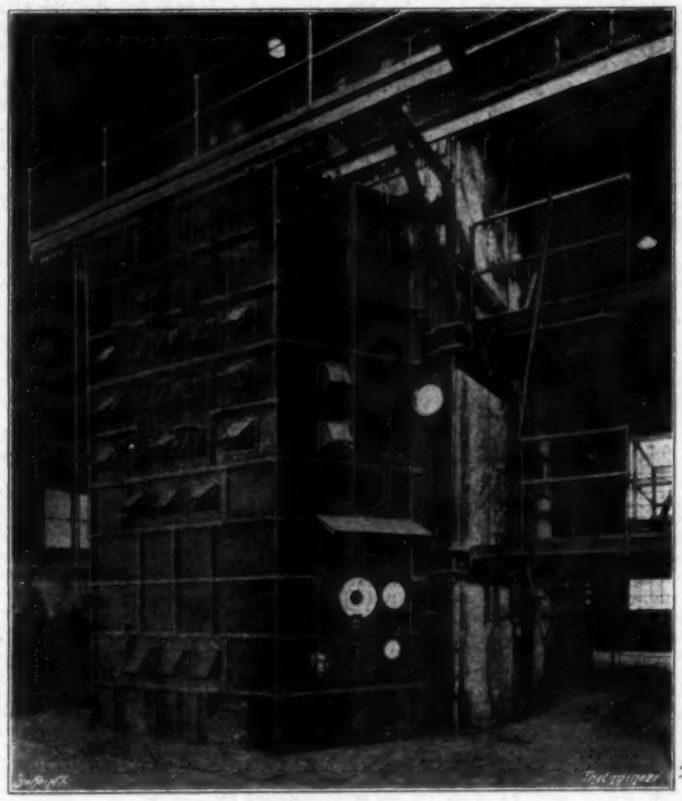
the combustion chamber is not utilised. For the time being, therefore, the tendency is towards the use of extremely large combustion chambers, which tend to reduce the efficiency on account of the excessive radiation of heat from the furnace walls. Further investigations should be in the direction of reducing the size of combustion chambers by employing improved methods of introducing the fuel into the furnace.

It is well known that if the furnace temperature is too high the ash fuses, and either runs from the ash-pit in the form of liquid slag or collects in the furnace in a semi-fused condition, and can only be removed with difficulty. Investigations have therefore been made by the Combustion Engineering Company to determine whether with a suitable design of furnace the ashes cannot be deposited in the bottom of the chamber in an unfused condition so as to permit of their easy removal. Furnaces have been fitted with water-cooled screens, through which the ash in a very fine state of subdivision is caused to fall and afterwards to collect in a lower chamber, which is sufficiently cooled to preclude the possibility of the particles collecting into a sticky mass. Tests extending over periods of twenty-four hours or more have shown that water-cooled screens are successful, but they are only to be regarded as temporary arrangements. With improvements in the design of furnaces and in the application of burners the necessity for these water-cooled screens will, it is said, be removed.

The high velocity at which the coal is admitted to the furnace in accordance with the present system is rendered necessary by the fact that the coal is delivered in a state of suspension, and the velocity must be sufficient to maintain the coarsest particles contained in the fuel in this condition. If it were not for the necessity of keeping the coal in suspension the velocity could be reduced to that of the air which passes through the air spaces of a grate belonging to a mechanical stoker. Exceptionally large combustion chambers would be unnecessary, and it would appear to follow that as the degree of subdivision of the coal is reduced, that is to say, by grinding the coal less finely, the velocity of the coal through the pipes and nozzles must be increased. Thus with the present system the coarser the coal the greater is the size of the combustion chamber. Further research work is being conducted with a view to determining what modifications must be made to overcome the difficulties that have arisen, and it is confidently expected that sooner or later powdered coal will be largely used in power-houses; but it is considered that there will always be conditions under which mechanical stokers will be preferable.

Among the pulverised fuel plants which have been built and installed by the Combustion Engineering Corporation, of New York, that at the River Rouge Works of the Ford Motor Company is perhaps the most interesting. The steam raising plant consists of four Ladd 2640 horse-power boilers, which have easily evaporated 215,000 lb. of water per hour when fired with pulverised coal; but they are designed so that they can also be fired with blast-furnace gas. A cross section through one of the boilers is shown in Fig. 72. When the construction of this plant was under consideration it became apparent that the supply of blast-furnace gas would be insufficient to raise the quantity of steam necessary, and as a result of an investigation extending over nearly two years it was decided that in view of the conditions governing the efficient combustion of blast-furnace gas and powdered coal being very similar, the installation of pulverised coal plant would give the best results.





FIGS. 74 AND 75—STIRLING BOILERS WITH LOPULCO PULVERISED COAL EQUIPMENT

The coal is first crushed so that it will pass through a 1¼in. ring, and is then delivered to an overhead bunker with a capacity of 700 tons, which is sufficient for a seventeen-hour run when all the boilers are working at 250 per cent. rating. At present there are four 6-ton Raymond separation mills, and the coal is fed into these mills from the coal bunker through cast iron pipes in predetermined quantities. When the coal has been pulverised so that it will pass through a 200-mesh screen it is taken from the mill by a current of air and gathered into centrifugal collectors and is afterwards discharged into elevators, which deliver it into screw conveyors which supply the boiler bins. From these bins the pulverised coal is fed by standard Lopulco feeders through Lopulco triplex burners. Each boiler is fitted with twelve feeders and four burners. The feeders consist of a heavy cast iron hopper, which forms the bottom of the bin, and in the bottom of this hopper is a cast iron screw which is driven by a variable-speed motor; but in the case of a duplex feeder the speed is changed by a Reeves variable-speed device. At the end of the screw where the powdered fuel is discharged there is a sleeve, which surrounds the screw and forms the wall of an annular orifice through which the air is admitted for the purpose of carrying the coal to the burner. The coal and air, on arriving at this point, are united and further agitated by four paddles which revolve with the screw. Both the fuel and air are therefore thoroughly combined and the finely divided coal is aerated so thoroughly that the resultant mixture is practically a heavy gas. An illustration of some feeders of the Lopulco pattern is given in Fig. 73.

There are several types of Lopulco burners. Those used on the boilers at the Ford Motor Works are known as triplex burners, and have three rectangular chambers surrounded by air ports. A 3½in. fuel nozzle passes through the inner chamber of each burner and terminates at a distance of 9½in. from the outlet, thus giving the mixture a chance to expand a little before it enters the furnace, with the result that when the powdered fuel is combined with the secondary air admitted through the air ports of the burner and

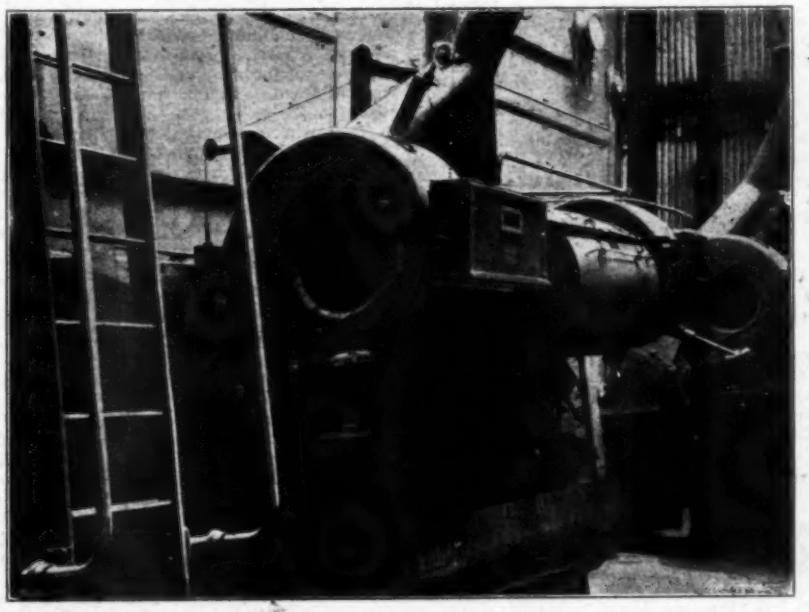


FIG. 76—SELF-CONTAINED TRAVELLING GRATE STOKER WITH FANS AND COAL METER

through auxiliary air inlets on the furnace, there is instantaneous combustion. About 10 per cent. of the air needed for combustion is supplied to the coal as a carrying medium, and the remainder of the air, which is known as secondary air, enters through the ports in the burner and through the auxiliary air openings in the front of the furnace in the manner described. The unique features of the installation, apart from the size of the boilers, are the absence of dryers in connection with the pulverising plant, the provision of an interlocking push-button control system, which makes it impossible to start the pulverisers until all the conveyors and elevators are in motion, and the burning of blast-furnace gas in combination with powdered coal. The gas is introduced into the boiler horizontally at a lower level than the coal, and it passes through a specially designed grid burner. Another type of burner has been designed for dealing with a combination of gas and powdered coal, and this is to be used in connection with another plant, where the gas and coal will be brought in at the top of the furnace in accordance with standard practice. The arrangement adopted at the Ford plant is only permissible on large boilers.

When using pulverised coal, the secondary air for combustion is controlled entirely by the stack damper. The covers on the mixing oven furnace are raised by a special lifting device when the boiler is put into operation, and they are not adjusted again unless the capacity at which the boiler has to work has to be varied over a wide range. To avoid the formation of slag and the destruction of brickwork, a multiple zone furnace is employed. Just under the arch or roof of the mixing oven furnace is the hot zone, where the combustion occurs. Below that is the neutral zone, whilst the third and lowest stratum is the cooling zone. The lower zone is maintained at a temperature below that of the fusing point of the ash by means of auxiliary air inlets. Boilers fired with pulverised coal in accordance with the Lopulco system are said to have been running for over three years, without repairs to the brickwork. The two Stirling boilers shown in Figs. 74 and 75 are installed at the St. Joseph Lead Company's works at River Mines, Missouri, and they are being operated with pulverised coal at from 200 to 225 per cent. of their normal rating and with flue gas temperatures of 580 deg. to 690 deg. Fah. The air inlets referred to above in connection with the Ford installation are to be clearly seen in both the front and side views of the boilers.

The self-contained impelled draught travelling grate stoker shown in Fig. 76 has been designed by the Underfeed Stoker Company to economise power and to bring together in one self-contained unit the fans, shafting and mechanical connections which are usually distributed in various quarters. It has been customary in the past to place the fans which supply the air under pressure in a position remote from the stokers and to pass the air to the stokers through ducts of considerable length. It has also been common practice to operate a series of stokers from one line shaft. Under many conditions, the ducts and the line shafting may be used without difficulty, but in other cases such arrangements are objectionable, owing to the space they occupy. It is known, moreover, that with long ducts as much as half the total power absorbed by the forced draught fan is utilised in overcoming the resistance offered to the passage of the air by the surfaces and bends of such ducts, and the power absorbed by the line shafting with its driving mechanism is generally more than that required to drive the stokers. These considerations have led to the self-contained impeller draught travelling grate stoker, which is claimed to offer the following advantages:—The scattered fans, shafting and mechanical connections to the stoker are brought together in one self-contained unit; the difficulty of maintaining the parts of the mechanical drive in alignment is eliminated; little attention is required to ensure proper lubrication; the fans attached to the stoker in the manner illustrated improve the ventilation of the boiler-room, as a current of air is induced towards the fans; and they remove the dust which is created at or near the hoppers of the stokers. The stoker may be removed from the furnace without having first to break joints with an air duct or to disconnect any driving mechanism. Owing to the direct flow of air from the fans to the underside of the grates and the elimination of shafting, the power for driving the fans and the stoker itself is reduced to one-third of 1 per cent. of the power generated by the boiler. There is a further saving in power during periods of light loads, for when a boiler is shut down the stoker, fans and shafting are put out of action, whereas when fans are used for serving a number of boilers they must be kept running continuously. A self-contained unit can be completely assembled and thoroughly tested before leaving the works. The preparation of foundations is greatly facilitated, the simplicity of a natural draught stoker setting is retained, and the designer of the power station is not concerned with the disposition of the shafting and motors.

THE Public Works Committee in Sydney (N.S.W.) has formulated a scheme for the amplification of the city's water supply, and has recommended to Parliament that the work be carried out as a matter of urgency. The estimated cost is £2,812,792.

Stainless Steel and its Properties.

IN our issue of June 3rd we published an article in which we summarised the case for and against stainless steel, as disclosed in the replies to letters which we had addressed to a considerable number of engineering and other firms who had used or tried or were using the material. The position disclosed, it may be recalled, showed a wide diversity of opinions regarding the utility of this variety of steel. While some firms expressed themselves highly in favour of it, one or two were as emphatically opposed to its use—at least for their particular class of work. An extensive range of minor uses of the material was recorded, but—with the exception of table cutlery—there was no instance reported in which it was being used on a large scale, although it was not unlikely in some cases that it might come into extensive employment if preliminary tests then being carried out gave satisfactory results.

Our previous article may be said to have summarised the position from the user's standpoint, although by way of conclusion we gave the views expressed by the original discoverer of stainless steel, Mr. Harry Brearley, on certain points raised by some of our correspondents. We now propose to go farther into the case from the makers' standpoint, for it seems undoubtedly to be the fact that some part at least of the difficulties and troubles encountered in the use of stainless steel is to be ascribed to the lack of a complete understanding of its nature on the part of certain users.

It is important at the outset to note that the term "stainless steel" by itself should not be used as an exact specification of a particular material, for there are almost as many qualities of stainless steel as there are of ordinary steel. In ordinary steel the mechanical properties depend mainly upon the percentage of carbon which they contain. Thus a steel which is to be easily forged and machined should not contain more than .35 to .40 per cent. of carbon. For medium purposes, such as for use in the manufacture of railway tires, springs, hot working tools, &c., the carbon content ranges from .45 to .70 per cent. For edge tools, taps and other cutting implements, steels containing .75 to 1.0 per cent. carbon are chosen. In the same way stainless steels may be classified according to their carbon content. At Brown Bayley's steel works the following grades of stainless steel are actually made:—

Stainless Iron.—Carbon, less than .10 per cent. Tensile strength, 30 to 70 tons, according to heat treatment. Easy to forge, drop stamp, machine and work cold.

Mild Stainless Steel.—Carbon, .1 to .2 per cent. Tensile strength, 40 to 80 tons. Easily forged under power hammers. Can be hardened and used for cutting tools for soft materials.

Medium Stainless Steel.—Carbon, .2 to .3 per cent. Tensile strength 45 to 90 tons. Too hard to forge by hand, but can be forged into simple shapes under power hammers. Intense air hardening property. Must be carefully cooled. Suitable for sharp and durable cutting tools and for hard-wearing surfaces.

Stainless Steel.—Carbon, .3 to .4 per cent. Tensile strength 50 to 110 tons. Forging qualities, &c., as for medium stainless steel.

Hard Stainless Steel.—Carbon, over .5 per cent. Difficult to forge. Possesses great strength at high temperatures. Stains more easily than milder varieties.

That the mechanical properties of the above different kinds of stainless steel are varied by varying the carbon and not the chromium content may perhaps surprise some readers. Yet, as is shown in the following typical analyses, the chromium percentage can be substantially constant in steels having very different mechanical properties.

	Stainless iron.	Mild stainless steel.	Stainless steel.
Carbon	.07	.15	.37
Silicon	.08	.09	.19
Manganese	.12	.16	.15
Chromium	11.7	11.8	12.0
Nickel	.57	.77	.55

In the course of our previous article it was made apparent that one of the commonest "faults" found with stainless steel was the alleged difficulty of forging it. From what has been said above, it will be understood that in all probability those who found this difficulty were using an unsuitable quality of the steel. It is therefore desirable that the makers' views on this question of forging should be made known to possible users.

Stainless iron, the material with the lowest carbon content, forges, it is stated, as easily as an ordinary steel containing .45 per cent. of carbon. As the carbon content increases, forging becomes more difficult until with the hard varieties the operation is almost as troublesome as in the case of high-speed steel. To illustrate the degree to which the carbon content affects the forging qualities, the statement may be quoted that four to six times as much work may be done on stainless iron at one heat as on ordinary stainless steel. Stainless iron may be easily forged by hand into such difficult objects as spurs, but for large articles or for articles made of the harder varieties of stainless steel a power hammer is indispensable. The temperature at which the forging is carried out requires attention in all the varieties. Between 900 deg. and 1150 deg. Cent. the materials can be forged by rapid blows without danger of splitting. But below 850 deg. to 900 deg. Cent. the deformation becomes more difficult, and if attempted with heavy blows the materials will be unduly stressed or broken.

Stainless steel may be drop-stamped at temperatures between 1000 deg. and 1200 deg. Cent., but for drop stamping the makers recommend the use of stainless iron, as with it the wear and tear on the dies is much reduced. It is advisable to do as much of the work as possible in preliminary shaping dies.

After forging or drop stamping, the steel, if allowed to cool in the air, will be hard. The hardness attained will depend upon the exact composition of the steel, the temperature at which it is forged or stamped, and the sectional area of the finished product. It may vary from 250 to 500 Brinell, and being of a more or less uncontrollable nature, should not in general be relied upon to secure a required degree of hardness. Whatever hardness is desired should be obtained by a separate treatment.

If the steel is required in a soft condition suitable for machining, it should be re-heated to 700 deg. or 750 deg. Cent. for about an hour and allowed to cool in the air, or quenched in oil or water. It can be made still softer by heating it to 850 deg. or 870 deg. Cent., followed by very slow cooling, but in this condition, like all annealed steels, it does not machine as smoothly as with the first treatment. It is worth noting that if the steel is subjected to the first treatment it should be magnetic when withdrawn from the furnace. If it is not, its temperature is too high or the soaking has not been sufficiently prolonged.

To harden stainless steel it should be heated to about 920 deg. Cent., and (1) cooled in the air if the section is small or the degree of hardness required is not great; (2) quenched in oil if the article is of large section and simple in design; or (3) quenched in water if the article is of symmetrical section and able to withstand great stresses. A hardened stainless steel object may be tempered by re-heating it to various temperatures. It should be particularly noted that the usual scale of colours is not applicable to stainless steel. The tempering operation is best carried out by means of a salt bath the temperature of which is controlled by a pyrometer. It is a peculiarity of stainless steel that after being hardened it may be re-heated to temperatures up to 500 deg. Cent. without any great effect on its hardness. Within this great range, therefore, it may be tempered to increase its toughness without softening it.

The effect of cold working on stainless steel is another matter requiring the close attention of users. Whatever opinions to the contrary may have been expressed, it is undoubtedly true that the material may be drawn into wire, rolled into sheets, or made into weldless drawn tubes. It is necessary, however, to modify the practice followed in these operations with ordinary steel. For example, the wire rod must not be "patented" before the wire is drawn from it, for the temperature at which patenting is done would make the rod hard and brittle. The air-hardening property of stainless steel must always be borne in mind; to soften the material, whether in the form of wire rod, hot-rolled sheet or hot-rolled tube, it should be re-heated to 700 deg. or 750 deg. Cent., and slowly cooled or quenched. The softened steel, after pickling in the usual acid, is ready for the first cold drawing or rolling process. The intermediate softening is carried out each time it is required by re-heating to 700 deg. or 750 deg. Cent.

It is to be remembered that all materials distorted by cold working show an increased tendency to corrode. Stainless steel is no exception to this rule, and, consequently, after it has been drastically cold worked, it should not be put into service until the internal stresses have been relieved by hardening, tempering or other heat treatment. It follows from what has just been said that stainless steel turnings or borings will rust, as will the surface from which the shavings have been removed, if the cut is rough. A surface finished with a fine cut is less distorted, and will, therefore, be less liable to rust than one finished with a rough cut. Grinding and polishing by removing the distortion make the surface immune from rusting. It is thus not the case, as has been frequently stated, that the freedom of stainless steel from corrosion is conferred upon it by polishing. A rough surface, if it is not distorted, will be rustless. The grinding of stainless steel also calls for special attention. It is more difficult to grind than ordinary steel of equal Brinell hardness, and if the softer varieties are ground rashly the surface may be distorted and the above-mentioned liability to corrosion set up. On the harder varieties rash grinding may produce soft spots which may stain or crack.

The behaviour of stainless steel at high temperatures is characterised by its non-scaling property and by its retention of a considerable proportion of its original hardness and strength. In an ordinary steel, after hardening and polishing, re-heating produces the well-known temper colours, which are really very thin films of oxidised metal. As the temperature rises a scale of measurable thickness is formed, and at a low red heat the thickness of this scale increases with the time during which the steel is exposed to the

corresponding temperature. Experiments have been undertaken to determine the loss of weight by scaling in the case of a variety of steels, including stainless steel. The steels were subjected for sixty-seven hours to a temperature of 700–725 deg. Cent., then for forty-six hours to 750–800 deg. Cent., and then for forty-six hours to 800–825 deg. At the end of this treatment the scale removed from a 5 per cent. nickel steel amounted to nearly 22 per cent. of the original weight. The scale removed from the stainless steel represented not more than half of 1 per cent. of the original weight. Other steels gave intermediate values, the next best result to that of stainless steel being shown by a 25 per cent. nickel steel with 2½ per cent. loss. A further treatment of twenty-three hours at 825–850 deg. Cent. caused the stainless steel to lose about 6 per cent. by scaling, the 25 per cent. nickel steel about 7 per cent. and the 3 per cent. nickel steel over 30 per cent. The retention of its hardness by stainless steel at high temperatures is shown by the difficulty of forging the higher carbon varieties. As for the retention of its strength, experiments show that high carbon stainless steel has a tensile strength of over 15 tons per square inch at 700 deg. Cent., as compared with less than 7 tons for ordinary mild steel, and about 9 tons for nickel or nickel-chrome steel. Only one other steel—a special high-speed material—excelled the stainless steel result with 17.7 tons. It is perhaps worth adding that Messrs. Brown, Bayley make certain high chromium, high nickel alloys which cannot strictly be called stainless steels, but which are much stronger at high temperatures either than stainless steel or high-speed steel.

Some remarks on the stainlessness of stainless steel may be added. The degree of resistance of the material to staining and rusting influences varies both with the exact composition of the steel and with its previous heat treatment. It is most resistant when it is in the hardened condition. When tempered at temperatures up to 500 deg. Cent., the material, as used for the manufacture of table blades, will not stain when exposed under standard test conditions to the action of vinegar. After tempering at 600 deg. Cent. it is generally found to be stainless under the test conditions. At 630 deg. Cent. it may or may not be stainless. Tempered at 700 deg. Cent. or higher, it stains in the vinegar test, but does not rust under ordinary conditions. If completely annealed at 850–870 deg. Cent. and cooled very slowly, it stains and rusts, but to a very much less extent than ordinary steel.

Nitric acid, cold or boiling, does not appreciably attack stainless steel, and cannot therefore be employed to etch it. It may, however, be etched by a mixture of nitric and hydrochloric acids, or by hydrochloric acid in which copper sulphate is dissolved. The material does not corrode when it is in contact with other steel. It is, however, attacked in an otherwise non-corroding liquid such as sea water when it is in direct metallic contact with copper or copper alloys, such as gun-metal.

In some quarters, we believe, it is thought that stainless steel has no advantage over a steel containing about 25 per cent. of nickel. On the contrary, it possesses a much greater resistance to corrosion. Moreover, it can readily be softened for machining purposes, and subsequently hardened to resist wear or heavy stresses, whereas high nickel steel is very difficult to machine, however it may be softened, while by no known process applicable to machined articles can it subsequently be hardened.

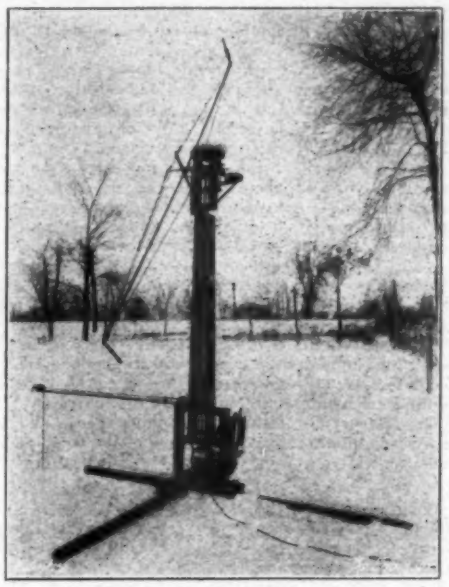
Fog Signalling by Means of Polarised Sound.

By ANDERS BULL.

DEVICES for sending sound signals through the air are in general use on ships and along shore for the purpose of warning and directing vessels in fog. Despite its defects, aerial sound signalling has held its own against more efficient methods of later date, the evident reason for such a fact being its extreme simplicity, both as regards equipment and operation.

An effective fog signal should be of a kind that will enable a pilot to determine with ease and certainty the direction from which it is coming. The direction of sound is usually estimated by instinctively comparing the intensity of the sensations produced in each ear. How extremely unreliable such observations are, especially when the sound-source is some distance away, is a matter of common experience. Our sense of intensity is crude, while the differences to be judged are very slight. Secondary effects are, moreover, produced that may throw the balance to the wrong side. These effects are mostly caused by reflection which takes place, not only from adjacent objects, but by changes in the density of the medium through which the sound waves are passing. Fog banks, as well as the layers of clear air between them, may thus act as reflectors, sometimes even to such an extent as to produce zones of silence at points at which the signals shortly before were clearly audible. Another disturbing agent is wind, which impedes observations by the noise it produces in the ears of the observer.

Details will now be given of a method invented by the author in which this defect of aerial fog signalling has been removed through the application of an acoustic principle, the salient feature of which is that the direction of the signals is determined from their pitch, a quality entirely apart from intensity, and governed only by the rapidity of the sound vibrations. Our sense of pitch is a highly developed faculty, so much so that variations of only a fraction of 1 per cent. are distinctly perceived. The advantage gained by making pitch, instead of intensity, the governing factor in the observations is, therefore, obvious. The author's device may be worked with any of the sound sources in use at present, such as whistles, horns, sirens or bells, without shortening



POLARISED SOUND SIGNALLING DEVICE

their range. No receiving instrument is used, and no code has to be consulted for the interpretation of the signals, the rules being simple and easily memorised.

The signals are produced in groups of four or eight, according to the accuracy of results desired, the signals of a group following each other at equal time intervals and being all of the same duration. To an observer listening to such a group, the individual signals will, as a rule, be partly of rising and partly of falling pitch. By counting the number of either kind he will be able to determine in what direction of the compass the signalling party is situated. This result is accomplished by means of what may be called a polarisation of the signals, the latter being endowed with properties depending altogether on their direction. In fact, one and the same signal is projected in one direction as a sound of rising pitch and in the opposite direction as a sound of falling pitch. The polarisation is brought about by putting the source of the signals through a series of rapid movements, the effect of which upon the sound waves will presently be explained.

The waves emitted by a source of sound, like a whistle, spread out over the surface of the earth, each wave moving out from the source with a velocity of about 1100ft. per second. As long as the whistle remains in one place all the waves produced by a blast will have the same centre and form a wave belt of uniform width—Fig. 1, A.

With the sound source in motion, the results are different. If, for instance, the whistle is moved at uniform speed toward the east—from O to R, Fig. 1, B—while a blast is being produced, then O will be the centre of the first (outermost) wave, and R that of the last. The wave belt is thus no longer of uniform width, the movement having crowded the waves toward the east. Their velocity remaining the same—1100ft. per second—the waves travelling eastwards must follow closer upon one another and give rise to vibrations of greater rapidity, so that to the east of the whistle the blast will have a higher pitch than to the north or south of it; while to the west, where the spacing of the waves has been increased, the blast will be of lower pitch. Toward the north and south the spacing of the waves is nearly the same as if the whistle had remained at rest, and therefore in these directions the blast will have the true pitch of the whistle; but the more the direction is changed toward the east or west, the more marked becomes the pitch difference.

It will now be assumed that the motion is oscillatory, the whistle being moved toward the east, from O to R—Fig. 1, C—at decreasing speed during the first half of the blast, and toward the west, back to O, at increasing speed during the latter half. Since the first and last wave both have their centre at O, the wave belt is again of uniform width; but the spacing of the waves within it is now variable. The first half of the movement, being eastward, has crowded the outer waves toward the east, while the latter half, being westward, has crowded the inner waves toward the west. As the pitch is governed by the spacing only, a person having the whistle east of him will hear a blast starting at a low pitch and rising, while another having the whistle west of him hears a blast starting at a high pitch and falling. Due north and south the waves are evenly spaced, and no change in pitch is observed.

It thus becomes possible to tell from the character of the blast whether the whistle is to the east or west, but not whether it is to the north or south. However, it is evidently as easy, by moving the whistle toward the north and south while blowing it, to produce a blast that will be different towards the north and south. If, therefore, the whistle is first moved east and west and then north and south, one blast being produced during either movement—Fig. 1, D—the observer may determine the east-west trend from the first blast and the north-south trend from the second. The character of the signals as projected in different directions is shown in the diagram by short lines of various inclinations, a rise from left to right indicating a rising pitch which is more pronounced the steeper the line, and *vice versâ*, while a horizontal line indicates a uniform pitch. Thus, when the whistle is north-east of a person, the latter will hear two rising blasts; when north-west, one falling and one rising; when east, one sharply rising and one uniform, and so forth.

A further increase in the number of blasts and directions of movement permits the localisation to be effected with greater accuracy. A convenient number is eight, each movement being then at a progressive angle to the preceding one of 22 deg. 30 min. (one-sixteenth of a circle). This number was used for the practical tests carried out last winter in a suburb of Chicago, Ill.

An oscillatory movement of the sound source being objectionable from a mechanical point of view, a rotation at uniform speed about a horizontal axis was substituted for it. In Fig. 2, representing a view above of the arrangement used, *a* is a horizontal axis, about which rotates the whistle *w*, describing a circle T R (seen edgewise) about O as centre. By a special

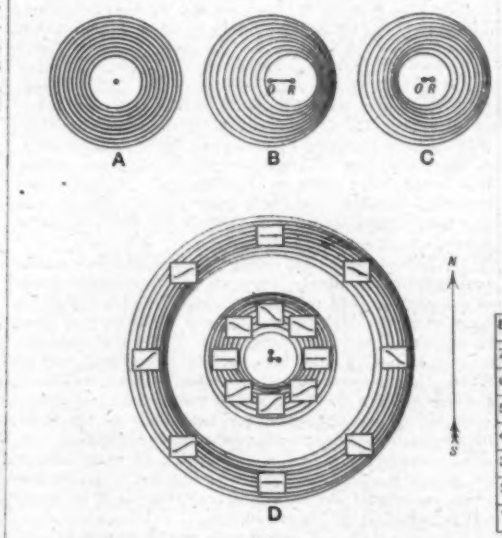


Fig. 1

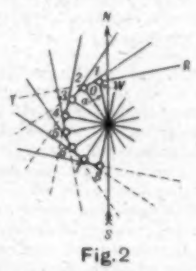


Fig. 2

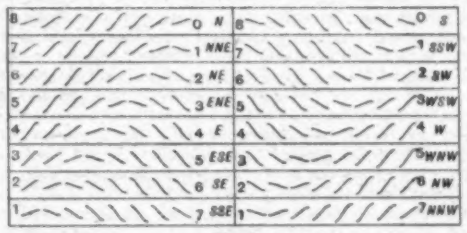


Fig. 3

SWAIN Sc.

DIAGRAMS ILLUSTRATING THE POLARISATION OF SOUND

arrangement the whistle is blown only during half its revolution, i.e., while moving through the semi-circle indicated by the full line O R. In this case the effect upon the sound waves proceeding in horizontal directions is the same as produced by the movement considered above. Starting with position 1 forming an angle with the meridian of 11 deg. 15 min. (one-thirty-second of a circle), axis *a* is given the successive positions 2, 3, . . . 8, one blast being produced in each. After eight blasts have thus been emitted the whistle is silent until axis *a*, after eight further displacements in the same direction (not indicated), has been brought again into position 1, whereupon the process is repeated. Each series of eight blasts is thus followed by a period of silence of about the same duration as the series itself.

In Fig. 3 is shown graphically how such a series of blasts sounds to an observer having the sender in the direction indicated to the right of each group. For instance, three falling and five rising blasts would mean that the sender is west-north-west of him, while one rising and seven falling blasts would indicate the direction south-south-east. The table is easily memorised by bearing in mind that the character of the first blast gives the east-west trend, and the predominating number of rises or falls the north-south trend. If the first blast is rising the situation of the sender is easterly, and the greater the number of rising blasts the more northerly is his situation.

The device is shown in the half-tone engraving. The whistle is seen at the extreme top, at the end of the cross-arm, which is made of tubing braced by stay wires, and is balanced by a counterweight at the lower end. The cross arm is rotated about its horizontal axis—*a* in Fig. 2—by a motor at the base, at a rate of 90 revolutions per minute. As the whistle is 5ft. 6in. from the centre of rotation its linear speed is about 50ft. per second. The whistle is blown by compressed air furnished by a pump to the right of the bottom frame, the air being first delivered to a reservoir at the top of the upper frame, whence it is fed to the whistle through a control valve operated by a cam on the shaft of the cross arm.

During the rotation of the whistle the upper frame is automatically turned about its vertical axis at a rate sufficient to produce the required change in the direction of the horizontal axis of the cross arm between each of the blasts. Means are also provided for adjusting the direction of the latter axis, a necessary feature for use on ships, in order to allow for changes in the course steered by the vessel.

During the tests no difficulty whatever was experienced in identifying a signal with its corresponding group as given in Fig. 3. Defining the position of the sender by the sixteen main directions only was found to be adequate for most purposes, and is convenient, as it requires only a simple count of the rising or falling blasts. Intermediate positions are, however, easily recognised, one of the blasts being then of uniform pitch.

Institution of Locomotive Engineers

EXCERPTS FROM THE PRESIDENTIAL ADDRESS GIVEN BY COLONEL KITSON CLARK ON OCTOBER 27TH AT CAXTON HALL.

THE one great movement of the present industrial world is reflected as much in the development of the locomotive as in that of the artificer. Both are being devoted more and more rigidly to specialised action.

The machine with unexpected latent powers, whose very inexactitudes assisted it to extraordinary achievements, may have to give place to a more powerful, more completely organised, more exact instrument, framed to conquer definite conditions, but likely to stop in unforeseen emergencies. So are men, endeavouring to alter the human, illogical, and kindly constitution of the past, into the direct *ad hoc* organisation that an idealist proposes, and is fortunate enough not to have to practise.

To extend these premises, it is apparent that the official world has decided to promote this *ad hoc* specialist movement. I find on notice boards posted about in a not unprogressive city of Yorkshire, "Education now needed more than ever," and I ask you to note that the education so much needed is in technical subjects.

The student, then, has to increase his specialised knowledge; he has to make himself remarkably efficient in one class of production, and I suppose that what is good for one is good for all, so that everyone is to aim at specialisation. When this education is complete he produces an amount of value to the world that has not been customary before, and his reward has to be increased at least proportionately. His work, where it is well organised and well calculated beforehand, is worthy of the reward. If, on the other hand, the tackle, the co-operation, and the preliminary calculations cannot be made and we cannot put a sub-expert to undertake the work, that is barred by a system of professional self-protection, then the work desired must be left undone.

Might I extend this in a simple illustration, far away from the subject.

I have a friend who owns woods of splendid timber in deep and difficult valleys. In earlier days, under the easy-going principles of the industry, it paid the world to cut this timber, remove it and use it. But while the efficiency of both mechanical and human agent has increased, so also has the cost, and the expense in these rather complicated localities has become so great that the timber cannot be removed and is going to waste. This is an example of the extension of education or manufacture *ad hoc*.

And so in matters of State; the unpaid worker is disappearing before the paid official; the amateur is considered of no account by the professional. It seems our people would have it so, and they may be right. Without doubt in a degree the best use is made of much definite power, but whether the sum total achieved is the best which is imaginable is a question I do not attempt to answer.

And now we come to the locomotive.

The education of the locomotive has made it into a very efficient, very expensive agent. Of its driver and fireman highly qualified and highly paid work is required. It must therefore be dedicated to tasks which demand its full power, and this entails an amount of administration and pre-arrangement which add to the overall cost of its service.

If we assume that what is good for one machine or man is good for all, then the ideal is that every individual machine or man should be expert at one process, and so we arrive at efficiency. But I sometimes wonder if Efficiency—now spelt with a capital E—is really the be-all and end-all of everything; it is a great minister in our modern materialistic life, but its lines are hard and its economics sometimes expensive. I might put, perhaps, a rider to this chapter of our translation: that there is still a place in man's policy for the general servant, and in the locomotive world for the old simple six-wheeled coupled goods engine; both can go anywhere and do anything.

The translation of the general into the special is, however, undoubtedly necessary in a very large measure.

* * * * *

With regard to the Battle of the Gauges it is difficult for us to carry ourselves back to the atmosphere of this great discussion. The fine proportions of the broad-gauge engines were the subject of great eulogy from its supporters, who described other railways as servilely following the dimensions of horse traffic, who cried out against that which the obstinacy of Stephenson had imposed for all time for this and other countries, and declaimed that the costly extravagances of the engineer Kilsby, whatever his triumph at the time, took no account of the future requirements of transit, and that accidents which had occurred on the broad gauge had not caused the loss of life or injury which would have taken place had they occurred on the 4ft. 8½in.

It is almost as difficult to reconstruct the picture which the following quotation from the life of the philosopher Babbage gives to us. He records that on one occasion, on a Sunday, the only day available for experiments, he arrived at the terminus a few minutes before the time appointed, and was told by the official placed at his disposal that he was to travel on the north line, *i.e.*, the up one.

"As this was an inversion of the usual regulations, I inquired very minutely into the authority upon which it rested. Being satisfied on this point, I desired him to order out my train immediately. He returned with the news that the fireman had neglected his duty, but that the engine would be ready in less than a quarter of an hour. The officer took pains to assure me that there was no danger *on whichever line* we might travel, as there could be no engine except our own on either line until five o'clock in the evening. A messenger arrived soon after to inform me that the obstructions had been removed and that I could now pass upon the south, which was the proper line.

"While we were conversing together, my ear, which had become peculiarly sensitive to the distant sound of an engine, told me that one was approaching. I mentioned it to the railway official. He did not hear it, and said, 'Sir, it is impossible.' 'Whether possible or impossible,' I said, 'the engine is coming, and in a few minutes we shall see its steam.' The sound soon became evident to both, and our eyes were anxiously directed to the expected quarter. The white cloud of steam now faintly appeared in the distance; I soon perceived the line it occupied, and then turned to watch my companion's countenance. In a few minutes more I saw it slightly change, and he said, 'It is indeed on the north line.'

"Knowing that it would stop at the engine-house, I ran as fast as I could to that spot. I found a single engine, from which Brunel, covered with smoke and blacks, had just descended. We shook hands, and I inquired what brought my friend here in such a plight. Brunel told me that he had posted from Bristol to meet the only train at the furthest point of the rail then open, but had missed it. 'Fortunately,' he said, 'I found this engine with its fire up, so I ordered it out, and have driven it the whole way up at the rate of fifty miles an hour.'

"I then told him that but for the merest accident of a delay I should have met him on the same line at the rate of forty miles, and that I had attached to my engine my experimental carriage and three wagons with thirty tons of iron. I inquired what course he would have pursued if he had perceived another engine meeting him upon his own line. Brunel said in such a case he should have put on all the steam he could command with a view to driving off the opposite engine by the superior velocity of his own."

Or a letter from Sir Daniel Gooch in 1838–9, when he expressed surprise that he had escaped serious accidents.

"It was no uncommon thing to take an engine out on the line to look for a late train that was expected, and many times have I seen the train coming and reversed the engine and ran back out of its way as quickly as I could. What would be said of such a mode of proceeding now?"

* * * * *

Many of us here can remember how the practical man, undisturbed by the blessed word "duplication," concentrated his thought on making the job a working job, and was content to range dimensions from a bare one-eighth to two bits of paper. Now we are touching implements of precision, we are in the period of tolerances of so many thous., and before long we shall, I feel no doubt, be transferred to the sphere of scientific instruments and deal in the figures of the metric system. Gone will be the unit which is constantly divided by halt, ½, ¼, ⅛, $^1/_{16}$, a device so well fitted to a machine that is built on two planes equidistant from a basic centre line, so useful for visible comprehension and for oral explanation. Gone will be the unit which includes the mysterious divisor of three, that has no practical appropriateness to us, whatever fundamental function it has in flanking a central object by two others; in dividing right angles by devices of equilateral triangles; in expressing the dimensions of our visible sphere. Gone will be the dimension which we have learnt to visualise, whether we got it from the measure of finger joints or the length of a foot. Gone the wonderful monument which preserves the age-long history of man's measurements.

ATMOSPHERIC CONDITIONS AND INDUSTRIAL EFFICIENCY.

A LECTURE delivered by Dr. H. M. Vernon, M.A., late Health Investigator for the Ministry of Munitions, at the Royal Institute of Public Health, on Wednesday, November 2nd, dealt mainly with the influence of ventilation in factories and workshops, and the effects of the humid atmosphere which is regarded as essential in some industrial processes. It was the third of a series arranged by the Institute. The lecturer first referred to the once accepted theory that the carbon dioxide exhaled from the lungs was harmful if existing in certain proportions. During the last few years, he said, investigators had come to realise that it was not so important to provide pure air in a workshop as to provide moving currents of air. Moving air, even if it contained a certain amount of exhaled carbon dioxide, was more invigorating to the worker than pure air which was stagnant. The difficulty, however, was to decide the velocity of air, as if it were too high it would cause a draught.

Dealing with the temperatures which should be maintained in workshops, Dr. Vernon pointed out that it varied with the nature of the work carried out. Curves thrown on the screen illustrated the temperature maintained in a munition shop, where workers were engaged in turning fuses, in a boot and shoe factory, and in a pottery. In the munition shop the conditions were ideal, the temperature being kept considerably above the outdoor temperature in the winter months, and slightly below that during the summer. In the pottery, however, the workers preferred a high temperature, and in the summer months it had considerable effect upon their output. He described also investigations he had carried out in tin-plate works, with a view to showing the decreased output of the workers during the hot summer months. In a works where no ventilation was provided for, taking the average output throughout the year as 100, the output varied from 110 in January to about 90 in the summer. Had a really efficient system of ventilation been installed in these works the average increase in output throughout the year would have been about 12 per cent. He gave figures to show that in a well-ventilated works the variation in output throughout the whole year was only about 3 per cent. A number of other figures were given, illustrating the same point.

A factor, he said, which was often lost sight of was acclimatisation. Some experiments he had carried out, with himself as the subject, consisted of doing mechanical work in a saturated atmosphere, and had shown that after some six weeks he was able to stand a higher temperature than at the beginning. Dr. J. S. Haldane had experimented in a Cornish tin mine, where the atmosphere was absolutely saturated, and had come to the conclusion that under such conditions hard physical work was well-nigh impossible. In linen and cotton weaving sheds the air was always humid, because a humid atmosphere was said to be necessary for the weaving operation. The effect of bad ventilation and humidity on the health of the workers in some industries was reflected in analyses which had been made of the mortality rate.

RESEARCH work carried on by the Société de Recherches de Vaux, with the co-operation of the Forages et Entreprises Minières, surrounding the village of Vaux, has resulted in an important discovery of natural gas at a depth of about 350 m. There is hope that the continuation of the work will result in important oil discoveries. A still more important result has been attained by the Société d'Etudes et de Recherches Petrolifères, which operates in the same area, near the village of Torcieu, with the co-operation of the Société Nouvelle des Sondages de Bonne-Espérance. They found a huge stock of natural gas, the daily supply of which reaches at present more than 100,000 cubic metres.

A Seven-Day Journal.

Improved Paris Air Services.

The sale of British machines to a French aviation company for use on London-Paris services is a distinct achievement on the part of the British aircraft industry. The Grand Express Aériens, who are the purchasers, have this week taken delivery of a new type Vickers-Vimy aeroplane. This machine, which is fitted with two 450 horse-power Napier "Lion" engines, will carry fourteen passengers, and at the designed speed of 130 miles per hour the trip between London and Paris should be performed in one hour and forty-five minutes. If rumour can be credited, this British machine is the first of several which are being acquired by the same company.

Empire and Power Alcohol.

The Imperial Motor Transport Council of delegates from Empire Governments has just held a conference under the auspices of the Empire Motor Fuels Committee. The discussion which took place turned mainly on the present position relating to customs and excise restrictions and as to suitable methods of denaturation. The Council, which includes representatives of British India, Australian Commonwealth, Union of South Africa, British Columbia, Quebec, and the Crown Colonies, decided to request the various Governments concerned to take the necessary action in connection with the subjects mentioned in order to facilitate the production and distribution of industrial and power alcohol throughout the Empire. A recommendation was also made that each Empire Government should consider the advisability of putting forward at a future conference proposals regarding the adoption of common methods of and formulæ for the denaturation of alcohol. It is hoped that the work of the Council will bear fruit. The need of doing everything possible to promote the use of Empire alcohol is quite obvious. The age of liquid fuel is being ushered in.

Flying in Fog.

Experience has made it quite clear that until a satisfactory device for enabling the pilot of an air machine to fix his position in foggy weather has been produced regular aeroplane services are impossible. Wireless direction finding has done something to simplify the problem, and much interest has been aroused by the claims made for the Reid indicator. The apparatus consists of an upper row of lamps controlled by a mercury device, a lower row controlled by a gyroscope, and an air speed indicator. It is asserted that by means of the signals given by the lamps and indicator it is possible for the pilot to obtain all the information which will enable him to fix his position during fog with practical accuracy, so that point-to-point flying can be undertaken with the certainty of reaching destination. The air speed of the machine, rate of turn, direction of sideslip, and movement necessary to preserve correct course are all recorded for the information of the pilot. As the result of experiments extending over a period of eighteen months, those associated with the new device, which is being manufactured by Vickers, Limited, recommend its use with great confidence.

Telegraph and Telephone Improvements.

The Post Office has now let contracts for the laying of over 800 miles of telegraph and telephone cables. The cables will connect a large number of towns with the main underground trunk system. London will be linked up by main cables to Manchester, Bristol, Brighton and Southampton; Liverpool will be connected to Manchester, Derby with Leeds, Birmingham with Bristol, Glasgow with Scarborough, Leeds with York, and Grimsby with Hull. The development of the local telephone will be associated with the laying of about 500 miles of new cables in various parts of the country. In the provinces, twenty-seven new exchanges are under construction and twenty-four existing exchanges are being extended. In London, eight of the exchanges now in service are being enlarged, and six new public exchanges provided, including one at Clerkenwell to accommodate an unusually large number of subscribers' lines. No statement has been made as to the extension of automatic telephone working in the London area, but it is known that the subject is receiving close attention on the technical side.

Significant Iron Imports.

Reference was made in these notes last week to the belief that the position of the British iron and steel trades was improving. This view of the situation did not suggest that foreign competition had ceased, but only that it was becoming less formidable. What it has been in past months is revealed by the statistics which have been issued by the Board of Trade during the present week. Imports of pig iron for the month of September reached a total of 121,711 tons, and wrought iron and finished steel products a total, in round figures, of 70,000 tons, representing in value about 1½ millions. The significant feature is that during the period when these imports were being made the home production of pig iron was only 158,000 tons, of which we exported, however, nearly 7000 tons at the price of over £10 per ton. On the other hand, the inclusive price of imported pig iron was only £6 per ton. Here is the key of the situation, the price of the imported material. The only really satisfactory feature of the statistics is that British manufacturers of special steels appear to have sold abroad over 100,000 tons at uncommonly good prices. Whereas foreign makers sold to this country 70,000 tons of finished products for £744,000, we obtained for 100,000 tons over 2½ millions.

Docking of H.M.S. Hood.

An old but interesting problem has come up in connection with the docking of H.M.S. Hood. It is understood that as the result of firing trials the plating of the ship has been strained, and it will be necessary for the newest British warship to be repaired as well as re-fitted. The straining of warship structures as a result of the firing of heavy guns came up for serious consideration during the war period, and it is one with which naval architects are quite familiar.

Wireless Telegraph Developments.

It was a somewhat remarkable feat which was carried out from the new American wireless centre at New York a few days ago. The message sent out by the President of the United States expressing his hopes of continued peace throughout the world was received wherever suitable apparatus had been installed. The new radio centre on Long Island is the most important of the kind that has yet been constructed, and when the whole of the equipment is in place it should be possible to conduct simultaneous communication with five different parts of the world. Transmitting apparatus is to be provided for both Transatlantic and Transpacific ranges, and the equipment has been designed to make provision for the inevitable development of Transatlantic wireless telephony. Important developments are also projected in Australia, where it is understood the Government is likely to enter into an arrangement with the Amalgamated Wireless Company for the erection of a high-power station capable of direct communication with both the United Kingdom and America. The experimental stations of the company have been able to give direct communication with New York and European stations for some time past, but the new station would enable a regular commercial service to be provided. It is reported from Australia that the company named would probably operate the new station under Government supervision, although the company would be quite prepared to finance and operate the station itself, or to sell its rights to the Government.

Ironworkers and Unemployment.

The somewhat novel request that the amount of unemployment benefit due to ironworkers on the North-East Coast should be contributed to the industry to enable additional men to be employed raises a somewhat complicated issue. Mr. Lloyd George, to whom the request was addressed by Mr. Howard Gritten, M.P. for the Hartlepools, stated that legislation would be required to enable the suggestion to be carried out, and expressed doubts whether in any case the object of reducing unemployment and assisting the restoration of trade could be achieved by such action. If such a principle were admitted it is obvious that a large number of firms would be able to qualify for grants immediately, and the inevitable sequel if the necessary money was forthcoming would, in Mr. Lloyd George's opinion, be to set up a universal system of subsidising wages from State funds. For these reasons the Prime Minister indicated the intention of the Government to limit unemployment payments to men who are actually out of work.

New American Submarines.

Details which have been given concerning a new type of submarine to be built in America indicate the considerable developments which are being made in submersible vessels. It is stated that the boats will be of over 2000 tons displacement, have a length of 300ft., a surface speed of 21 knots, and a submerged speed of 10 knots. The machinery equipment is stated to be a combination of gas and electric propulsion developing 6500 horse-power. Rumour indicates that two vessels of this type have already been laid down. The armament will be less formidable than that which has been installed in the latest British submarines, as only one 5in. gun is to be carried, but it will be mounted to serve as an anti-aircraft weapon. It is reported that six torpedo tubes have been included in the design. There are great expectations that these new submarines will have a much greater cruising radius than their predecessors, and 10,000 miles has been mentioned in this connection.

Harnessing the River Jordan.

The placing of a contract for a hydro-electric scheme in connection with the river Jordan by the Palestine Government has been the subject of an inquiry in the House of Commons. It appears that the contract was awarded to a Russian Jew named Rutenberg, and the Colonial Secretary was asked whether tenders were obtained from other sources before reaching a decision. The reply given indicates that the contractor is acting in co-operation with the Zionist organisation, and the Palestine Government as well as the Colonial Office decided it would be advantageous to Palestine that a concession should be granted. The works, which will utilise the waters of rivers Jordan and Yarmuk and other streams for the generation of electric power throughout the country, will, it is understood, employ local labour to a very large extent. The exact terms of the concession have not been stated, and it is uncertain whether the Government is assuming any financial responsibility.

Tube Railway Scheme.

The Government having rejected Lord Ashfield's proposals for a Government guarantee in respect of interest on capital for extensions and improvements to the London tube railway system, coupled with a practical monopoly of road transport for a definite period. Underground interests are now engaged in the task of framing an alternative scheme. Quite apart from the fact that the work would provide employment for a large number of men over a considerable period, the traffic requirements of the Metropolis call for the carrying out of the improvements and extensions included in the scheme. The most interesting part of the work from the engineering standpoint is the re-building of the City and South London tube to modern standards, and experiments have already been carried out near Stockwell station in order to test the proposed method of enlarging the tunnels. Greathead shields would be employed for the work, which would proceed simultaneously at many different points. With regard to the extension of the Hampstead line to Edgware, this would be a surface extension except for a tunnel about a quarter of a mile in length at Hendon. The application made this week for a guarantee of interest on capital for an extension of the Metropolitan Railway to Watford is regarded as somewhat ill-timed. This work is not of an urgent character, and is quite unlikely to obtain the backing of a State guarantee.

Oil Explorations in Papua.

The home Government has retired from the project of oil exploration in Papua, for which it was agreed that the British and Australian Governments should each subscribe a sum of £50,000. The Under-Secretary for the Colonies has now announced that having regard to the doubtful character of the project owing to the inability of geologists to make any favourable forecast and the original capital having been exhausted, it has been decided to leave the work for the Australian Government. It has been arranged, therefore, that the British interests shall be taken over by Australia for a sum of £25,000.

Sixty Years of Electrical Progress.

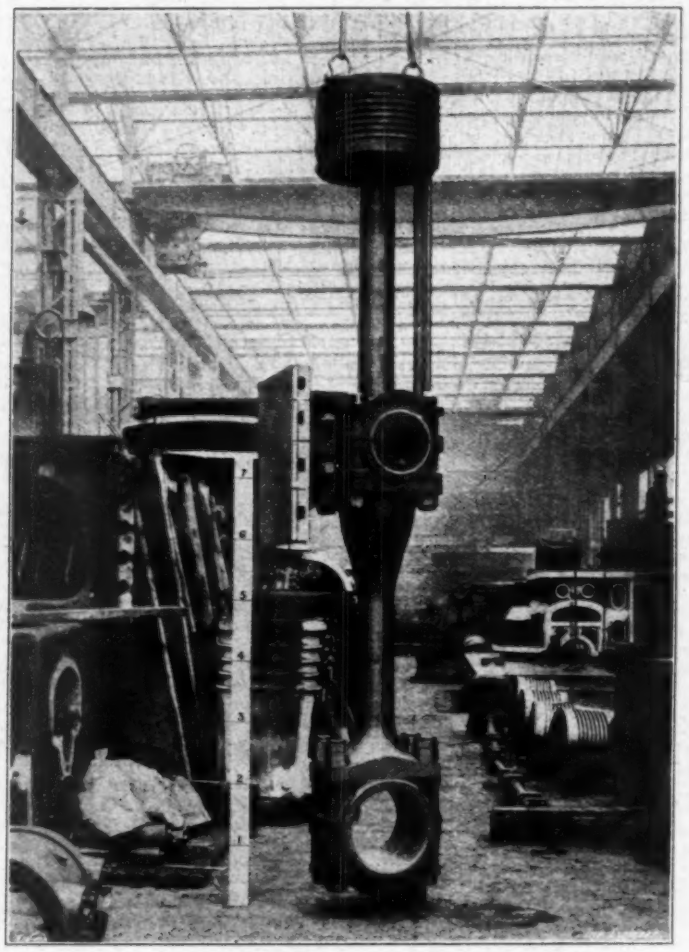
In celebrating, in the present week's issue, its sixty years of life, our contemporary, the *Electrician*, reviews the progress of electrical science and industry during this period. The files of the paper record the designs and commercial enterprise which, in 1880, made electric lighting possible, and, a decade later, the beginnings of tube railways in the City and South London Railway, then known as the City and Southwark Subway. The past sixty years, we are reminded, have also seen the invention of the telephone and the widespread adoption of the electric motor for industrial purposes. The pioneer work of Marconi, Hertz, Lodge and Fleming, which culminated in the invention of commercial wireless telegraphy, was also carried out during the life of our contemporary. Its pages have, it is justly claimed, chronicled the transformation of electricity from a little-understood science not only into a great industry, but into a means of improving civilisation. This week's issue contains congratulatory messages from many men of eminence in the domain of electrical science and application, and we join heartily in these congratulations.

Trials of the Beardmore-Tosi Marine Diesel Engine.

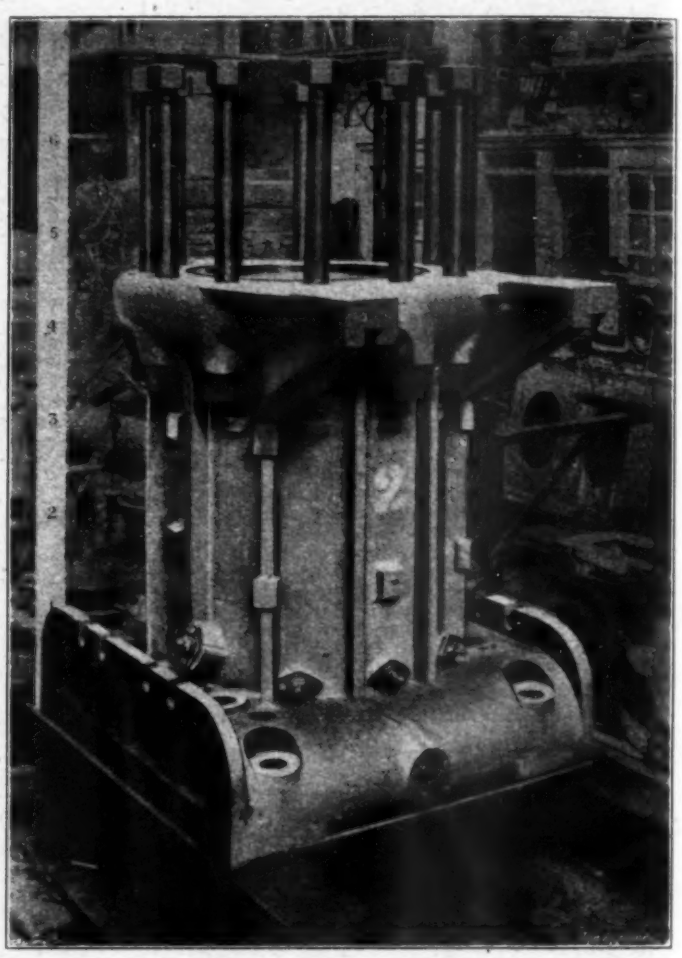
THE post-war development of the slow-speed marine Diesel engine in Great Britain has been characterised by an intensity and enthusiasm which bears favourable comparison with the less certain progress which was achieved during the years immediately preceding the war. One of the happiest features of the work of the last two years has been the more pressing duties and tasks with which those years were filled. Here and there, however, on the Continent, among our Allies and in neutral countries, some advance was made, and it is satisfactory to see that British builders have been able, by close association and common application, to take advantage of new and ingenious designs and render them still more valuable by imparting that robust construction which is characteristic of our marine practice.

Italian engineers have contributed much to the progress of the Diesel engine, and the engines designed and constructed by the Ansaldo, Fiat, and Tosi concerns have earned a high reputation. William Beardmore and Co., Limited, have the advantage of being associated with Messrs. Tosi Bros., of Legnano, Milan, as regards their Diesel work, and the Beardmore-Tosi engine, which has just completed extensive shop trials, is a striking example of the success of combined effort in the solution of engineering problems and the achievement of successful design. As constructors of both four-cycle and two-cycle engines, Messrs. Tosi Bros. made extensive inquiries into the relative merits of the two types before commencing the design of their marine engine. The four-cycle engine was accepted as having a lower mean cylinder temperature, with consequently more moderate heat stresses, enabling a simple design of liner to be used. The fuel consumption was also shown to be slightly lower on the four-cycle engines. Attention was given to the design of a special cylinder cover and valve gear, which, in its present form, goes far to remove the objection sometimes raised against the four-cycle engine on account of exhaust valve trouble and heat troubles with cylinder covers.

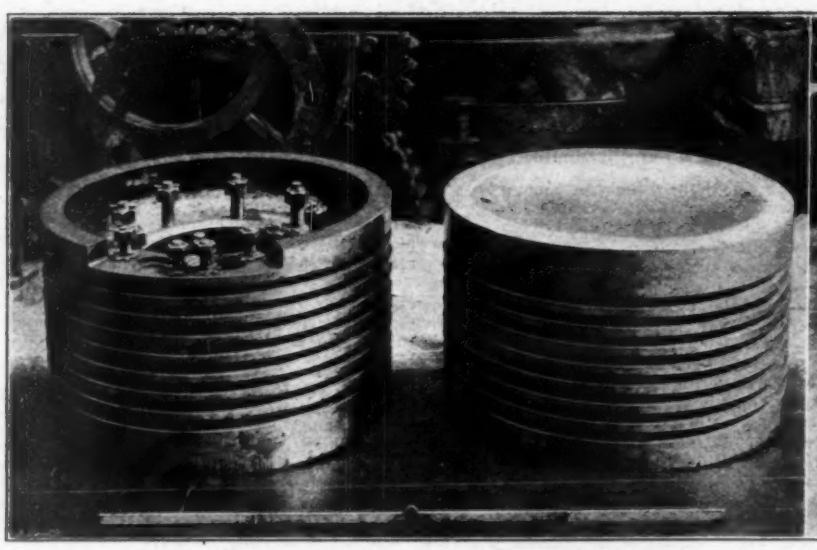
The design and working of the Beardmore-Tosi



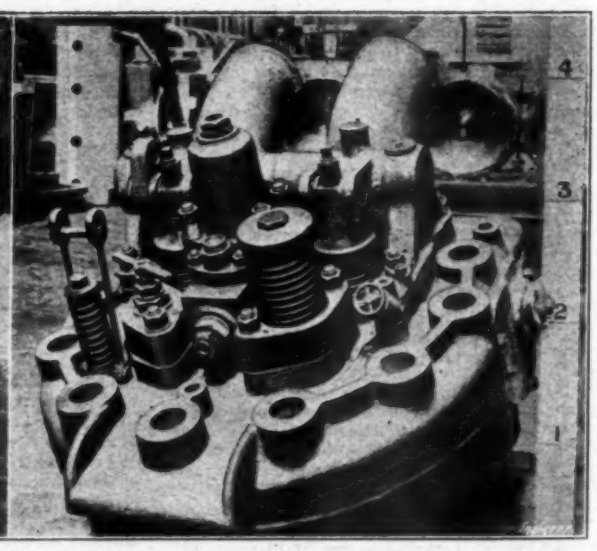
PISTON, CONNECTING ROD, ETC.



CYLINDER CASING



PISTONS



CYLINDER COVER AND VALVES

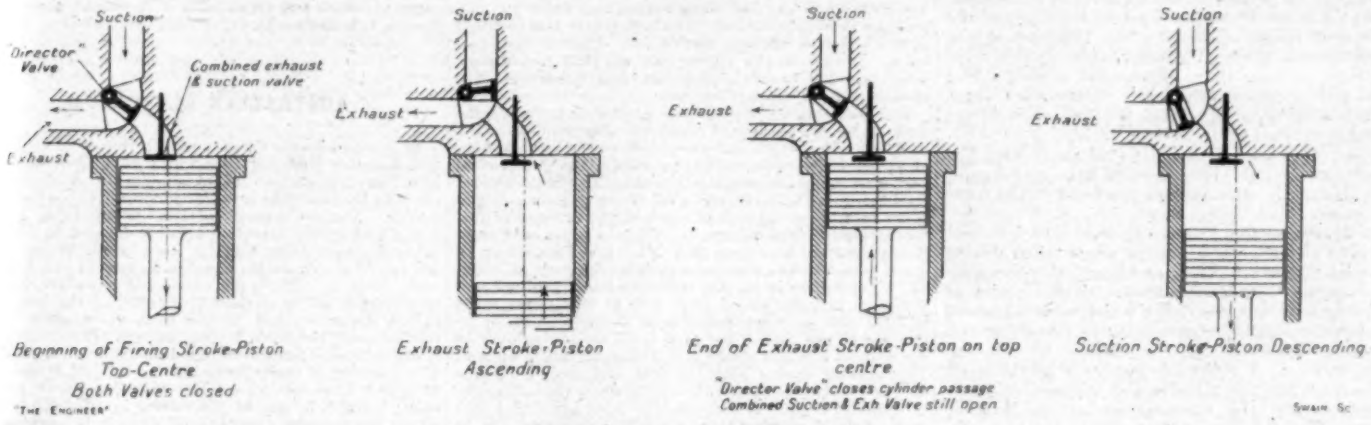
the construction of a number of engines of widely varying types built from both British and continental designs. The experience which is being obtained from the running of these engines in service will undoubtedly lead to a more accurate valuation of the relative merits of each particular type to the elimination of constructional defects, and to the evolution of engines increasingly capable of meeting the high demands of present-day mercantile marine practice.

During the war, the problem of the application of the Diesel engine to merchant ship propulsion was, in this country, largely set aside to make room for valve gear will be clearly understood from the accompanying sketches and the valve-tunnel diagram.

In addition to the usual air starting valve, fuel valve and relief valve, each cylinder cover is provided with two combined inlet and exhaust valves, controlled by two "director valves," operated by a simple excentric on the cam shaft. These director valves act in such a way as to place the cylinder space in communication with the air induction pipe or exhaust manifold as required. Thus, as the piston rises on its exhaust stroke with the combined inlet and exhaust valve open, communication is made

with the exhaust manifold whilst the induction manifold is shut off. As the piston passes the top centre to descend on the suction stroke the combined inlet and exhaust valve remaining full open, the director valve changes its position, giving communication with the induction manifold and shutting off the exhaust manifold.

It will thus be seen that although the combined inlet and exhaust valves are exposed to the heat


Suction
"Director" Valve
Combined exhaust & suction valve
Exhaust
Beginning of Firing Stroke-Piston Top-Centre Both Valves closed
Exhaust Stroke-Piston Ascending
End of Exhaust Stroke-Piston on top centre
"Director Valve" closes cylinder passage Combined Suction & Exh Valve still open
Suction Stroke-Piston Descending
"THE ENGINEER"
SWAIN Sc

DIAGRAMS OF ACTION OF DIRECTOR VALVE

of the exhaust gases, they are immediately cooled by the incoming charge of cool air, and the air current further gives a scavenging effect which sweeps the valve faces clean and prevents any formation of carbon deposit. The excellence of this arrangement of valves was clearly proved on examination of the valves after the 100 hours' trial, when the faces were found to be quite clean. Moreover, the pyrometer fitted at the point where the exhaust gases enter the manifold showed a temperature of about 514 deg. Fah., indicating considerable cooling of the exhaust gases due to the lowering of the temperature of the inlet and exhaust valves and passages by the entering air. The mechanical design is simple and efficient, enabling a robust construction to be carried out in both valves and cylinder head. The director valves themselves are of cast steel of tee section with a solid spindle, and are so arranged that they do not rub any surface and the power to operate them is practically negligible. The inlet, exhaust, fuel and starting levers are of substantial construction and show evidences of careful design.

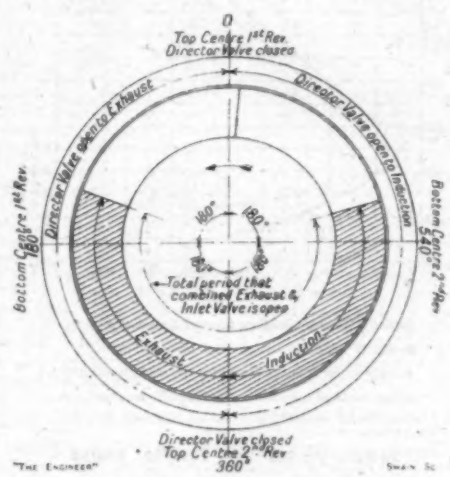
The fuel valve is of the usual needle type, but so constructed that no packing glands are required and the possibility of sticking is almost entirely eliminated. The valve is so arranged that it can be ground in without dismantling any of the other valve gear.

The cylinder casings are of interesting construction, as will be noted from the accompanying engraving. The cylinder liner, which is of simple design, is supported at the top in such a manner that it may expand freely in the downward direction. Spiral ribs are fitted on the top portion of the liner to increase the velocity of the cooling water and ensure even cooling at the part subjected to the greatest temperature. These ribs also give additional strength. Bottom diaphragm plates provided with stuffing-boxes for the piston-rod and piston cooling tubes are fitted to each cylinder, thus separating the working cylinders from the crank case and preventing contamination of the main lubricating system. The construction used also allows of inspection doors being placed at the back of each cylinder at the base, enabling ready examination of the liners, pistons and cooling tubes to be made whilst the engine is running. The space which is formed at the base of the cylinders when they are bolted together forms an efficient air

pipe being supported on feet cast on to the pipe. The pipes are simply clipped to each other and to the cylinder heads by covering bands, which allow the manifold to take up its own position and so avoid any stress due to expansion either on the engine or on the pipe line.

The construction of the piston and connecting-rod is clearly indicated in the accompanying illustration. The piston itself is of special cast iron, fitted with eight rings of the Ramsbottom type. It is interesting to note that the crown is very thick, varying from 6in. to 7in., the designers being of opinion that the mass of metal helps to conduct away the heat. Fresh-water cooling is adopted on the present engines, but there seems to be no reason why sea water should not be used as a cooling medium if so desired.

The connecting-rods are of the usual marine type, with cast steel white-metal-lined top and bottom bushes. The general construction of connecting-rods,



VALVE OPENING DIAGRAM

crossheads, columns, crank shaft and bed-plate approach very closely the accepted lines of marine engine design. The columns are of cast iron, and carry the crosshead guides on one side only, allowing easy accessibility for the inspection of the crosshead bearings and telescopic tubes supplying the piston-cooling water. The guides are water-cooled, and visible outlets are provided. The bed-plate, which is in three sections, is of the usual box type construction,

to full astern in seven to eight seconds, and accelerated from a minimum speed of 28 revolutions per minute or retarded to a maximum speed of 130 revolutions per minute, without the slightest tremor or vibration.

Trial Results, Beardmore-Tosi Marine Diesel Engine.

Six-cylinder engine. Cylinder diameter, 620 mm. (24⅜in.), stroke, 975 mm. (38⅜in.). 1250 brake horse-power at 125 revolutions per minute.

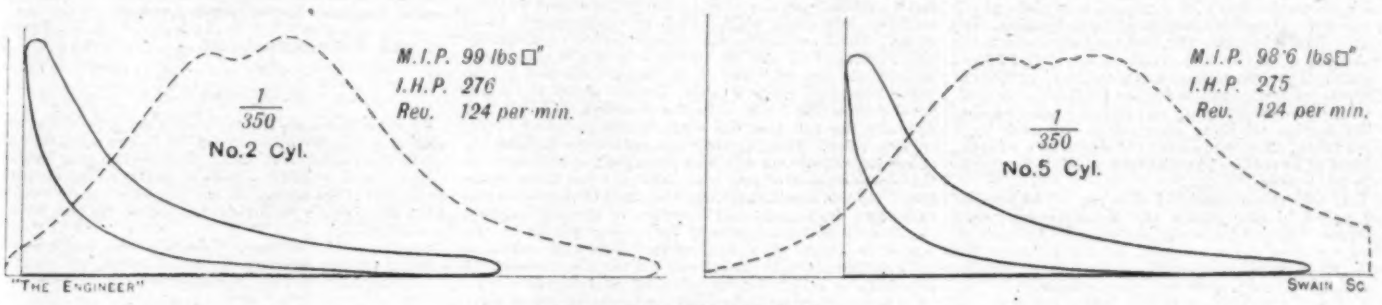
Six Hours' Overload Trial.

B.H.P.	1332
Mechanical efficiency, per cent.	75.5
I.H.P.	1766
Revolutions per minute	129.6
Mean pressure on B.H.P. basis, lb. per square inch	76
Fuel consumption, lb. per B.H.P. per hour	.411
Exhaust	Invisible

100 Hours' Trial.

Average B.H.P.	1267
Mechanical efficiency, per cent.	77
Average I.H.P.	1646
Revolutions per minute	124
Mean pressure on B.H.P. basis, lb. per square inch	75.5
Fuel consumption, lb. per B.H.P. per hour	.42
Lubricating oil consumption, total for cylinders and loss, gallons per twenty-four hours	4–5
Exhaust temperature, average at exit from exhaust valve, deg. Fah.	550
Lubricating oil pressure, lb. per square inch	10–12
Circulating water pressure (jacket), lb. per square inch	10–15
Piston cooling water pressure, lb. per square inch	20–30
Water temperature at outlet from cylinder heads, deg. Fah., average	125
Piston cooling water, outlet temperature, deg. Fah., average	130
Blast air pressure, lb. per square inch	1000

The reversing and manœuvring gear, which has been designed by Messrs. Beardmore, is simple in construction, and works with unusual ease. The gear is so arranged that the valve levers are lifted and the cam rollers slid along from the ahead to the astern cams, which stand side by side with the cam shaft. The movement is carried out by a light steel shaft carrying the fingers which engage the rollers. The whole operation is effected by an electric servo-motor, which operates the mechanism and clearly indicates on dials at the control station the direction of rotation of the engine and the sequence of starting. The



TWO TYPICAL INDICATOR CARDS

suction silencer, and is connected by a central pipe to the main induction manifold, which runs the length of the engine at the back of the cylinder covers and is fitted with louvres at the fore and aft ends. This arrangement has the advantage that it prevents any blow back from the pistons vitiating the air in the engine-room. The exhaust manifold is of a very neat design, each section of the water-cooled exhaust

and forms, with the columns and the bases of the cylinder casings, which are bolted together, an exceptionally rigid construction, which reduces vibration to a minimum.

The crank shaft is also in three sections, and is forged from the solid in special heat-treated Beardmore steel. The sections are so designed that in case of necessity one can be lifted and secured

engine starts with three cylinders on air, then three on fuel and three on air, and finally six on fuel, the gear being of the all-round type. All parts of the reversing mechanism are interlocked so that the gear is practically fool-proof and no false start can be made.

The control and manœuvring can be carried out by one man, for the valves for blast air and starting air, and the connections with the auxiliary generator

engines and auxiliary compressor are all placed within easy reach of the attendant at the control station.

As the present engine will be fitted in a single-screw ship, a complete duplicate blast receiver is fitted, both receivers being interconnected. The fuel pump, which is fitted with the usual suction control and cut-out gear, is placed at the front of the engine within easy reach of the control attendant.

The two air compressors fitted at the forward end of the engine are of three-stage design, each compressor being amply large for the full capacity of the engine. Suction air controls are provided on the front of the engine and gauges indicating the pressure in the various stages. The cooling water systems are divided into three, serving the compressors, cylinders and heads, and pistons respectively. Indicators which show when the separate pumps for these systems are running are placed at the control station.

Forced lubrication is fitted to all parts with the exception of the valve levers, which have grease cups, and indicators for this system are fixed at the front of the engine.

The figures of the 6-hour overload and 100-hour trials here given, with a pair of cards taken during the trial, indicate the excellent performances of the engine. Following these trials a series of demonstration trials were held, which were witnessed by a large company, representing shipbuilding and shipowning interests and the various British and foreign surveys. A noticeable feature of all the trials was the quiet running of the engine, its quick response to control, and the maintenance of an invisible exhaust. The Beardmore-Tosi engine marks a distinct advance in four-cycle engine construction, and its performance in commercial sea-going service will be awaited with great interest and expectation. The first engine will be installed in a single-screw vessel, fitted with complete electrical auxiliaries, the current being supplied from Diesel-driven dynamos. The trials of this vessel are expected to be run in a few months, when we hope to have the pleasure of giving further particulars and plans of the machinery in the ship.

Tests of an Aero-Engine.

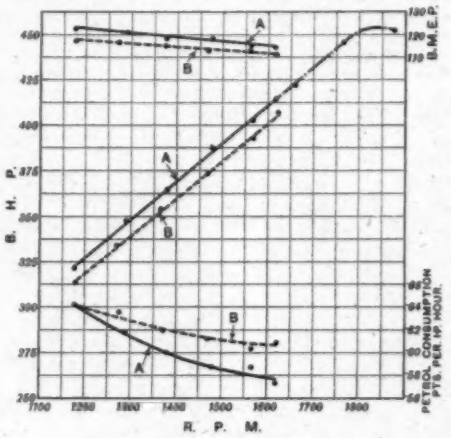
In our issue of May 30th, 1919, we published an illustrated description of the nine-cylinder static radial 400 indicated horse-power air-cooled "Jupiter" aero-engine as made by the Cosmos Engineering Company, Limited, of Bristol—formerly Brazil, Straker and Co., Limited. Some time ago the design and manufacturing rights of the "Jupiter" and other aero-engines made by the Cosmos Company were acquired by the Bristol Aeroplane Company, Limited. Of the different designs thus taken over, that of the "Jupiter" engine is perhaps the most noteworthy by reason of its performance, its low weight, the fewness—relatively—of its parts and its economy of consumption. That the claims made for it in these respects are fully justified is emphasised by the results shown by the engine when it was subjected recently to tests in accordance with the Air Ministry's Engine Type Test Schedule of 1920. Previously, only two designs of engine had passed this very rigorous test. Both were of the water-cooled pattern. It can thus be claimed for the Bristol "Jupiter" that it is the only air-cooled engine that has satisfied the test conditions. In addition, it is stated to be the lightest aero-engine to have been proved by an official test.

The engine on which the tests were made was manufactured under conditions complying with the Air Navigation Regulations of 1919, and had previously been run for 17 hours 41 minutes. The majority of the different tests were carried out by coupling the engine through a cardan shaft and universal joints to a Heenan and Froude dynamometer, the tail extension of the dynamometer shaft being itself coupled through a dog clutch to a 100 horse-power variable-speed motor. To simulate the cooling effect on the engine when in the air a "Sirocco" fan driven by a 270 horse-power shunt-wound motor was used to direct a current of air on to the engine. The air current had an average velocity of 85 to 90 miles per hour as measured at the axis of the duct at a point 5ft. away from the engine. In accordance with the test schedule requirements, the engine was run for 20 hours out of the 50 in the endurance test with a propeller in place of the dynamometer. The slow-running and acceleration tests were similarly conducted. The fuel used throughout the tests consisted of 80 per cent. aviation petrol and 20 per cent. benzol. The consumption was measured by means of a flow meter with check tests for the total amount used. Lubricating oil was supplied under pressure from a 9-gallon tank, the surplus oil being returned to the tank by a scavenger pump. The temperature of the oil at the intake was controlled as required by the test schedule by means of an electric heater.

The first test taken consisted of a run of 50 min. at varying speed, during which the horse-powers, mean effective pressures, and fuel consumptions were determined. The data recorded are represented by the three full-line curves given in the accompanying diagram. It will be seen that the horse-power rose proportionately to the speed from 321.5 at 1176 to 415 at 1620 revolutions per minute, while as the speed increased the fuel consumption per horse-power fell off from .642 pint at the lowest speed to .576 pint at the highest, the average being .594 pint. The 50-hours endurance test at 90 per cent. of the nominal power was then carried out. During this test the load on the brake was reduced. The speed was almost constant at 1575 revolutions per minute, the brake horse-power averaged about 348, and the fuel consumption varied from .589 to .603 pint per horse-power-hour. For a period of 20 hours durng this test the engine was run on the propeller at 1575 revolutions. During this time no measurement of the power was made, while the consumption could only be recorded as averaging 197.8 pints per hour.

Next followed a slow-running test of 30 min. duration. The speed recorded was 393 revolutions per minute. In the course of this test, carried out on the propeller and not on the brake, the running of the engine was reported as being steady and the acceleration as good. The engine was then subjected to a 1-hour high-speed test, purely with the object of testing the bearings. In carrying out this test the load on the brake was considerably reduced and the throttle partly closed. As a consequence the speed rose to 1789 revolutions. The horse-power developed was 292, while the fuel consumption amounted to .608 pint per horse-power hour. The high-power test required by the schedule was next carried out. The test lasted an hour. During it the engine ran at 1623 revolutions, developed 399 brake horse-power, and consumed .613 pint of fuel per horse-power hour.

Following all the tests enumerated above, the engine was run for the purpose of re-determining the data of the first test. The results as regard horse-power, consumption and mean effective pressure are shown by the three dotted curves in the accompanying diagram. It will be noticed that there was a slight falling off of the horse-power and mean pressure at all speeds and a slight increase of fuel consumption. The diminution of horse-power was practically constant at about 12 at all speeds, while that of mean pressure was also substantially constant at about 4½ lb. per square inch. On the other hand, the fuel consumption increase varied from zero at the lowest speed to .033 pint per horse-power-hour at the highest, or an increase of less than 6 per cent.—not something over 50 per cent. as a casual glance at the diagram might suggest. The weather during both the first and second "power curves" tests was fine, with the barometer substantially constant at 29½in. It may thus be fairly concluded that as a result of running this engine for something like 53 hours under rigorous conditions the efficiency at the lowest speed was not affected, while that at the highest speed suffered a fall of about 6 per cent. Such a fall in such a time would, in the case of an ordinary prime mover, be a matter for serious investigation. But in an aeronautical engine it is of little or no importance. That this is so may



Curves "A" indicate readings taken at beginning of run.
Curves "B" indicate readings taken at end of run.
Average Petrol consumption during run .594 pts. per BHP. hr.
Power readings corrected for atmospheric pressure.
Chain dotted line indicates power obtained after Type Test.

"The Engineer" Swain Sc.

POWER CURVES FOR JUPITER ENGINE

perhaps be more readily conceded if we say that on the average an aero-engine is usually given a complete overhaul after about 250 hours' running. In any event the fuel consumption of the "Jupiter" engine—.594 pint per horse-power hour on the average over all the tests—is, for an air-cooled aero-engine, so low that an increase in it of about 6 per cent. after more than 50 hours' running still leaves it in a very favourable position relatively to other aero-engines of its class, and quite comparable with aero-engines of the water-cooled type. It may be added that the average consumption of oil was .049 pint per horse-power hour, and that on dismantling the engine after the tests very little signs of wear were visible.

Following the conclusion of the second "power curves" test a modified cam sleeve was fitted to the engine without, however, any other adjustments or replacements being made. This cam sleeve was designed to give a slightly altered timing to suit an increase in the engine speed beyond the normal. The chain-dotted extension of the upper horse-power curve in the diagram shows the power developed at the brake with the modified sleeve in use. Actually the full and the chain-dotted portions of the curve overlap. Thus, at 1560 revolutions per minute, the power developed was 406 with the modified sleeve, while the consumption of fuel was .596 pint per horse-power hour. At this speed, therefore, the effect of the sleeve was to restore the output and efficiency of the engine practically to their initial values. Increasing the speed, the power rose and the consumption decreased until, at 1875 revolutions, the output was 462 horse-power and the consumption only .566 pint per horse-power hour.

As a final test the engine was set to run at 90 per cent. of its normal power, namely, 345 horse-power, at 1575 revolutions. The fuel from one of the three carburetters was then cut off, so as to make the engine run on six cylinders instead of on nine. Under these conditions the engine was run for one hour. The vibration was naturally noticeable, but was not excessive. The speed was 1250 revolutions, the horse-power 193, and the fuel consumption .685 pint per horse-power hour. It is of interest to note that with three cylinders "missing" in this manner, the power developed was a little less than two-thirds of the normal, while the speed was considerably more than two-thirds.

The weight of the engine, as officially determined, was 729½ lb., excluding the exhaust pipes and intakes, or 1.9 lb. per horse-power taking the normal output as 383 brake horse-power.

The figures quoted in this article provide, we think, very convincing testimony to the degree to which the development of the aero-engine has now been carried. That the power of something like four hundred horses can be produced by a machine which can be carried by four men is surely a remarkable engineering feat. That the engine should at the same time be demonstrably trustworthy, possess a high efficiency and have a very wide range of output and speed, more than doubles our admiration for this fine product of the engineer's art.

AUSTRALIAN ALUMINIUM.

It is hoped by the Commonwealth Bureau of Commerce and Industry that inquiries which have been instituted into the manufacture of aluminium in Australia will result in the establishment of the industry in the Commonwealth. Various deposits of bauxite are being investigated, and special attention is being devoted to ore from Wingello, near Moss Vale, in New South Wales. This ore carries a recoverable alumina content of about 35 per cent. This, in itself, is not considered attractive, but if a treatment could be devised for employing the iron oxide in the deposit—about 40 per cent.—aluminium manufacture would become a paying business. Efforts are being made to interest some of the steel companies in the matter. The quantity of easily accessible ore in sight is set down at about 4,000,000 tons. The only deposit at present being worked is one at Marraoan, in Gippsland, Vic., where the Sulphite Company of Victoria is carrying out operations. Aluminium to the value of £60,224 was imported into Australia in the fiscal year 1918–1919, and of that amount £47,946 represented the manufactured article.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

UNEMPLOYMENT.

Sir,—You do me an injustice. My letter was not based on a "ca' canny" spirit, but on scientific reasoning. The investigations of economists during the last hundred years have led them to accept as principles (1) that the rate of output per hour increases as the number of hours worked per day is reduced, down, at any rate, to eight hours; (2) that the rate of output per hour increases with the wages, up to a certain point. These two principles are on a different plane altogether to the question of ca' canny. I do not deny that a slight increase in hours or a slight decrease in wages might cause a slight increase in output per £1 total cost. I do contend that a large increase in hours and a large decrease in wages would cause a decrease in output per £1. I maintain that you cannot in these ways get such an increased output per £1 as to put you on a level with the Germans. Again, I doubt whether you are right in thinking that the difference in output per day between 1914 and 1921—apart from difference in hours per day—is entirely or even mostly due to ca' canny. Reaction from overwork during the war accounts for something, loss of many of the young, vigorous and skilled for something, and lazy Army habits for a good deal. Further, if a workman's ca' canny fraction is, say, a half, you are not likely to make it any bigger by reducing his wages and increasing his hours. Lastly, a good way out of a difficulty is to find out the cause; and there, at any rate, we shall be agreed. Decreased production, though it may be a cause, is certainly not the chief cause of the present trade depression.

November 7th. F. T. W. Lewis.

[Our view is that increased production, even for the same wages as at present rule, would encourage trade and reduce unemployment.—Ed. The E.]

SIGNALLING ON THE LIVERPOOL OVERHEAD RAILWAY.

Sir,—With regard to your kind reference to my father on page 488 of the current number, I trust you will allow me to point out, in justice to my father, that he was greatly in favour of track circuit; in fact, in 1896 he took out a combination patent embodying this with his other ideas in connection with electrical signalling.

The chief difficulty in using this on the Liverpool Overhead Railway was the fact that at that time the running rails were used as the return for the operating current.

E. W. Timmis.

London, S.W. 1, November 7th.

A FIREMAN'S DUTY.

Sir,—Perhaps some of your readers might be willing to say what they consider a fair amount of coal to ask a fireman to handle in an eight hours' shift. We have two 30ft. Lancashire boilers in use at a time, four furnaces, and the coals are in bunkers within 8ft. of the furnace doors. The approximate amount of ash is 20 per cent. The fireman has to clean the fires, but a boy removes the ash.

R. Orde, House Governor and Secretary.

Royal Victoria Infirmary,
Newcastle-on-Tyne, November 8th.

DRAG-BOX CASTING AS AIR RESERVOIR.

Sir,—In reading in your last week's issue—November 4th—Mr. Poultney's article on the new Caledonian 4–6–0 engines, I noticed that the writer when referring to the Westinghouse brake arrangements, suggests that the utilisation of the footplate or drag-box casting as an air reservoir is novel. I beg leave to point out that the late Mr. R. J. Billinton adopted this practice on the majority of the engines, both tender and tank, designed by him for the London, Brighton and South Coast Railway.

Coventry, November 7th. Wm. E. Briggs.

Railway Matters.

We have to record with regret the death on Monday last of Lieut.-Colonel P. G. von Donop, R.E. (retired), who was appointed one of the inspecting officers of the Board of Trade in July, 1899; became the senior inspecting officer on the retirement of Sir Arthur Yorke in July, 1913, and retired, owing to age limit, in August, 1916.

It is announced that Lord Peel has been appointed Minister of Transport (unpaid) in place of Sir Eric Geddes. It was generally expected that Mr. Arthur Neal, the Parliamentary Secretary, would have been promoted, but this would have necessitated his re-election. That would have caused considerable inconvenience at this time, when so many documents, some connected with relief works, need signature.

The official announcement of the appointment of three members of the Railway Rates Tribunal, mentioned in this column on the 4th instant, has now been made. We would add to the information given as to the members that Mr. Locket is a member of the firm of Gardner, Locket and Hinton, coal factors, shipowners, &c. He has been for many years the chairman of the Association of Private Owners of Railway Rolling Stock and a prominent protagonist of the rights of the privately owned wagon.

A war-time concession was that youths were paid at men's rates, when they reached eighteen years of age. The men's unions recognise that this rate is no longer justified, and that the restoration of the former practice would save money to the companies, and on the 27th ult. an agreement was signed whereby the former practice will be reverted to, and youths will not be paid at men's rates until they reach twenty years of age. No change is to be made in the existing rates for youths between eighteen and twenty years.

On the 24th ult. the President of the Board of Trade was asked whether the Ministry of Transport had become or was about to become a department of the Board of Trade, and, if so, could he say what reductions could be made in the staff which it employed at the present time. Mr. Stanley Baldwin replied that the arrangements for the future conduct of the Ministry were under consideration, but had not yet been decided. By the settlement of the railway companies' claims, a re-organisation of the Ministry was made possible. Substantial reductions in the staff had already taken place and others were being made.

Considerable progress was made during the year ended June 30th last in the installation of automatic signalling on the New South Wales Government Railways, especially on the main southern line, where automatic working is in use for 214 miles. The proportion of non-interlocked connections in passenger lines has been reduced from 11.48 per cent. to 10.13 per cent. Progress on the renewal of the permanent way has not been satisfaction on account of the impracticability of obtaining sleepers in adequate quantities. An arrangement has been made with the Forestry Department for the opening of a training school for sleeper cutters.

At Barrow Town Council meeting on Monday, the 31st ult., it was reported, in connection with relief work, that there had been interviews with Vickers Limited and the Furness Railway Company on the proposed scheme for constructing a new entrance to the channel and widening the passage into Barrow docks, to afford passage for the largest merchant vessel or warship afloat or contemplated. The negotiations are proceeding. The main entrance to Barrow docks is a little short of 100ft., which was reckoned ample when Ramsden Dock was first constructed, but such is the size of merchant and war craft to-day that the entrance is too small and the water too shallow for them. The new battleship just ordered would be too large for the docks.

The want of uniformity among the British, French and Belgian nations as to the date for the cessation of summer time has caused no little inconvenience to those having charge of the cross-Channel timings. The boat train due to leave Dover at 8.15 a.m. was not altered, and passengers had therefore to wait an extra hour at that station. A passenger having sent a letter of protest to *The Times*, has drawn a reply from Mr. P. C. Tempest, the general manager, who says that to have advanced this particular train by one hour for three weeks would have led to it reaching London when every section on the up lines by all the various routes was occupied by one business train closely following upon another. To have found room for this train would have meant disturbing thirty-one others, each with a load averaging 500 passengers.

When the railways of the United States passed under Federal control the United States Railroad Administration opposed the payment from railway funds of money towards associations, societies, and clubs except those it approved of. Some were put under the American Railway Association—which in many features corresponds with our Railway Clearing House—and among them were the Master Mechanics' Association and the Master Car-builders' Association. Recently the Association of Railway Executives decided that in view of the imperative need for the exercise of all possible economy all annual and special meetings are to be indefinitely postponed. Members are therefore writing to the American railway Press, suggesting that these two associations should break away from the American Railway Association and be "on their own."

In this column of our issue of September 30th, we mentioned that the Midland Railway (Tilbury section) would not accept the new widened stock of the District Railway, which could not, consequently, proceed further than Bow-road, and this relief to congestion, otherwise possible, was not available. We are glad to be able to report that the new stock is now running freely between Bow-road and Barking. A tale is told, for the accuracy of which we cannot vouch, that this arrangement came about by some of the carriages being sent over the line by accident, an incident which unexpectedly proved that there was sufficient clearance. Should it happen that this is not the fact, we are, of our own knowledge, able to say that by an unintended journey of this sort certain rolling stock of an English railway, declared to be outside the gauge limits of some tunnels in Scotland, was found to pass through these tunnels safely.

Notes and Memoranda.

The latest American novelty is a small single-seated electric motor car for use in factories which cover a large area, so that the officials may be quickly transported from point to point. The car is fitted with a battery capable of running a distance of 50 miles on one charge. The wheel base of the vehicle is only 5ft. 5in. and the track 2ft. 11in., so that it is small enough to pass through doorways and along the works' aisles without difficulty. It is also claimed that the car will effect a saving of time in the distribution of written instructions to various parts of large establishments.

The November issue of *Rubber Age* contains an interesting reference regarding the use of rubber for papermaking. The journal points out that as the result of many years' experience of and experiments with rubber in various forms a patent has been taken out by Mr. Fred Kaye. The invention, it is explained, is briefly for mixing a percentage of rubber latex, as it comes from the tree, with the pulp from which paper is made. This can be varied in many ways, and the rubber latex can be added up to 20 per cent. of the mixing. A great many varieties of paper may be very considerably benefited by the introduction of rubber into its manufacture, although in some cases only a small percentage may be used.

The drawings supplied to drop forgers, states Mr. A. Stubbs in a paper read before the Coventry Engineering Society, should show the finished machined part, and the drop forger, when quoting, should be told what machining allowance has been made, and if necessary the quotation accompanied by a sketch showing, in addition to the machining allowance, the amount required for draft of dies and the position where the dies would be halved. The practice adopted by some engineering firms of sending two drawings, one showing the finished machined part and the other a stamped drawing, has much to recommend it. The drop forger with this information before him can not only decide which are the most important dimensions or points to be watched, but can often make suggestions which make either for economical production or a better article.

A method for cleaning joints and cracks in concrete pavement before filling with tar is described as follows in the *Concrete Highway Magazine*:—The method involves the use of a 30ft. length of ¾in. rubber hose, provided with a ¾in. gas pipe nozzle. The hose is attached to the exhaust pipe of the small motor truck used for hauling the tar kettle and other tools. The end of the gas pipe nozzle is drawn down to ¼in. diameter. The crack or joint to be cleaned is first freed from any tightly packed dirt by means of a metal hook. The material thus loosened is then dislodged by directing the exhaust of the motor, by means of the hose and nozzle into the joint. The motor is speeded up to produce the necessary pressure at the nozzle. This method leaves a clean crevice. The exhaust gases, being warm, evaporate any moisture that may be present in the concrete.

Twenty years ago China's cotton spinning industry was represented by two mills with 65,000 spindles; in 1902 the numbers had increased respectively to seventeen and 565,000; in 1920 they were sixty-three and 1,422,832. Some twenty additional mills are under construction or projected. There are four British-owned cotton mills in Shanghai with 248,756 spindles, while the Japanese are credited with sixteen mills and 469,000 spindles. Speaking generally, on account of Chinese cotton being of short staple, the Chinese mills have so far confined themselves to the production of yarn, but looms have been installed in some of the larger mills on which a fair amount of cloth is being produced. These cloths compete successfully with similar cloths from Japan, but there does not seem to be any likelihood of the Chinese being able to produce anything approaching the Lancashire textiles for many years to come. The Chinese Government has an arrangement in the matter of remission of taxation which is of great benefit to the native product.

Electrical energy is the ideal power for oilfield purposes other than drilling, and its use is steadily extending. The chief objection to it, states Mr. A. Beeby Thompson, is the high capital expenditure on works needed for duties of a non-permanent character, but for simplicity, convenience, and cleanliness, there is no equal either in the distribution of power or character of the motors. Another objection sometimes advanced is the high speed of motors that makes it necessary to introduce gearing or countershafting for many purposes. The great advantage of electricity lies in being able easily to shut off the power when not required. In practice, oil and gas engines are kept running during periods of intermission of work, and steam engines have to be kept running to avoid water accumulation in engine and pipe lines which must be drained at periods when machinery is idle. Condensation in mains proceeds and radiation of heat continues whether work is in progress or not. On the other hand, electrical stations of insufficient size to take comfortably the peak loads that are occasionally thrown on the plant are a constant source of trouble.

At the recent general meeting of the American Electrochemical Society, three general types of transformer oil sludges were discussed by Mr. Q. J. Rodman, of the Westinghouse Research Laboratories. The first, or asphaltic, sludge is produced by the oxidising action on poor transformer oils such as contain unsaturated compounds, water, small resinous bodies, and certain accelerators or catalysers. Examination of the sludge showed that it consisted largely of hydrocarbons of high molecular weight containing oxygen. Thus it may be considered as a combination of oxy-asphaltic compounds. It is the most general form of sludge. It collects upon the active parts of the transformer, thus preventing the dissipation of heat. If it is free from moisture its electrical properties are fairly good. The second type, or soap sludge, is a good moisture and oxygen carrier. It forms slowly and it is difficult to remove entirely by filtration. The third type, or the carbon sludge, is due to electrical breakdown. Commenting on Mr. Rodman's paper, Mr. W. S. Moody, of Schenectady, described a series of tests carried out at the General Electric works. These tests led to the conclusion that when the oil is exposed to air there is much sludging, and in the absence of air there is practically none.

Miscellanea.

The announcement is made that the Executive Committee has now completed the arrangements for the incorporation of the Industrial League and Council under the Companies Acts, 1908–1917, with a limit of liability, and the Board of Trade has given its sanction.

There has been registered in India a company with a capital of some £20,000,000, which proposes to establish ironworks on a large scale near the iron ore deposits of Bihar and Orissa. Iron ore, coal and limestone are found extensively and close together on the properties controlled by the company.

A recent report to the Department of Overseas Trade points out that the most important coal deposits in Mexico are at Sabinos and Coahuila, and are estimated to cover about 400 square miles. The coal is of a good coking quality. About 1,000,000 tons per annum were mined before the revolution, but the output has now fallen to about half. All the coal produced is used in the country, the bulk of it being consumed on the plateau; foreign coal is imported on the coast. The coal reserves in the country may be estimated at about 100,000,000 tons.

The Joint Industrial Councils of the Electrical Industry, acting for the cable-making, electricity supply and contracting branches, together with representatives of the Association of Electrical Manufacturers, the Wholesalers and the Electrical Development Association, held a conference on Monday, October 24th, to discuss the present conditions of unemployment in relation to the electrical industry, and to formulate measures which might be taken to secure the restoration of finance and trade within the industry and bring about alleviation of unemployment.

Oldbury District Council decided on Monday, November 7th, to commence work in connection with road improvements in the Warley districts. The cost of the work would be about £36,000, half of which would be met by a grant from the Ministry of Transport and the other half by loan. It was stated that just prior to the meeting of the Council on Monday, November 7th, a telegram was received from the Ministry of Health, stating that an inquiry would have to be held, but the Council decided not to delay the commencement of the work until after the inquiry.

The ninety-sixth Christmas Course of Juvenile Lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Professor J. A. Fleming, F.R.S., on "Electric Waves and Wireless Telephony." The lectures, which will be experimentally illustrated, will be given on the following days at three o'clock:—Thursday, December 29th, "Surface Waves on Liquids"; December 31st, "Waves in Air"; January 3rd, "The Telephone"; January 5th, "Electric Oscillations"; January 7th, "Electric Waves"; and January 10th, "Wireless Telephony."

The Petrograd correspondent of the *New York Herald* (Paris edition) reports that the Soviet Government has granted a concession to Dr. Hammer, representing the Allied Drug and Chemical Corporation of New York, covering the richest asbestos mines of Russia in the Ekaterinburg district of the Urals, and that this concession has already been signed. Dr. Hammer did not attempt to secure the majority of the old shares. Ignoring old claims, he took a twenty years' concession, which stands or falls with the Soviet *régime*. His firm is entitled to employ up to 50 per cent. of American or foreign labour.

An explosion, which, it is feared, will involve the loss of two lives, took place at the Hampstead Colliery, Great Barr, Birmingham, on Sunday morning last. Owing to the fortunate circumstance that very few men were in the mine at the time, it is not such a serious matter as it might otherwise have been. The Hampstead Colliery has been in the fortunate position, in these days of depression in the coal trade, of having been able to provide full work for the men. At the time of writing it is uncertain what effect the explosion will have upon the early resumption of work in the districts of the mine, other than the one in which the disaster occurred.

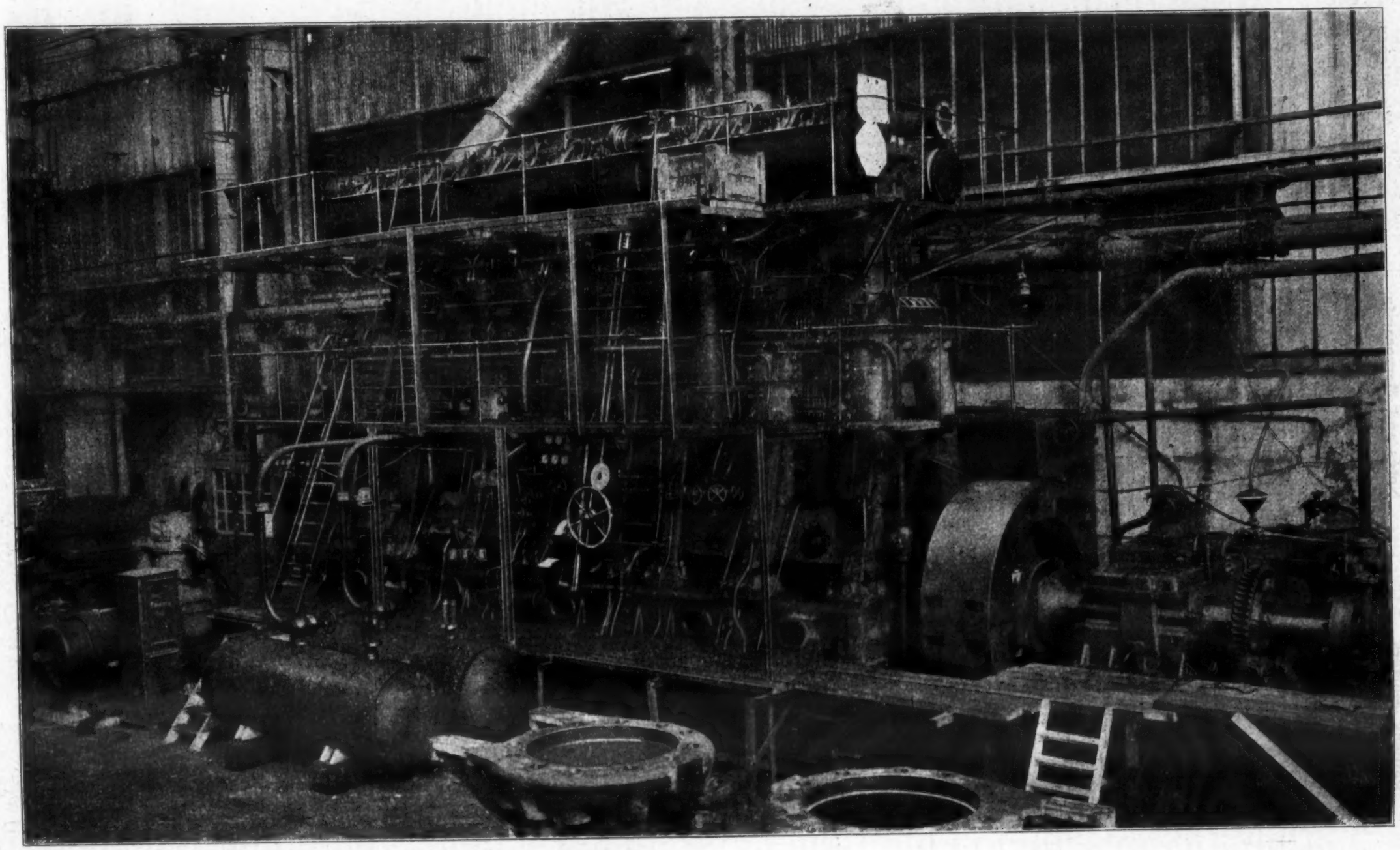
It is anticipated that the new White Star Line steamer Homeric, which is a twin-screw vessel of 35,000 tons, will enter the company's Southampton, Cherbourg and New York mail and passenger service in the spring, in which she will be associated with the Olympic, 46,439 tons, and later with the Majestic, 56,000 tons, the last named being the largest ship in the world. It is interesting to note that the White Star line, in addition to its numerous operations elsewhere, will then have engaged in the Transatlantic service from Southampton a fleet of vessels the total tonnage of which will be some three times that of the fleet which repelled the Spanish Armada. The Homeric, which is the largest twin-screw steamer in the world, and sixth in point of tonnage, has two funnels and two pole masts. She is 775ft. long, with a breadth of 83ft., and is propelled by triple-expansion engines, which will give her an average sea speed of 19 knots.

The Union des Syndicats de l'Electricité, of which Mr. Tribot Laspierre is the general secretary, has invited the following countries to send delegates to a conference to be held in Paris to discuss the various technical problems relating to high-tension transmission systems:—Great Britain, Belgium, Spain, United States, France, Holland, Italy and Switzerland. Mr. W. B. Woodhouse is to represent the Institution of Electrical Engineers, and Messrs. P. V. Hunter and E. B. Wedmore, the British Electrical and Allied Industries' Research Association. The Union des Syndicats de l'Electricité desires it to be known that, in addition to the delegates from the different countries specially nominated, the meetings will be open to all engineers who wish to attend. It is proposed that the conference should be divided into three sections, dealing with (1) power station operation, including sub-stations, (2) construction of lines, and (3) distribution. It is hoped that the delegates from each country will submit papers on the subjects brought forward for discussion. The meetings will be held at the offices of the Union des Syndicats de l'Electricité, Paris, and will commence on Monday, November 21st next, continuing until Saturday, November 26th.

1250-B.H.P. BEARDMORE-TOSI MARINE DIESEL ENGINE

WM. BEARDMORE AND CO., LTD., DALMUIR, ENGINEERS

(*For description see page 508.*)



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*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

The Engineer, November 11th, 1921. PAGE

Recent Locomotive Practice on the Caledonian Railway. No. II. (Illustrated.) .. 499
Institution of Mechanical Engineers .. 500
Developments in Power Station Design. No. XV. (Illus.) .. 502
Stainless Steel and its Properties .. 504
Fog Signalling by Means of Polarised Sound. (Illustrated.) 505
Institution of Locomotive Engineers .. 506
Atmospheric Conditions and Industrial Efficiency .. 506
A Seven-day Journal .. 507
Trials of the Beardmore-Tosi Marine Diesel Engine. (Illustrated.) .. 508
Tests of an Aero-engine. (Illustrated.) .. 510
Australian Aluminium .. 510
Letters to the Editor—
Unemployment .. 510
Signalling on the Liverpool Overhead Railway .. 510
A Fireman's Duty .. 510
Drag Box Casting as Air Reservoir .. 510
Railway Matters .. 511
Notes and Memoranda .. 511
Miscellanea .. 511
Leading Articles—
Science and Industry .. 513
Efficiency .. 513
Institution of Electrical Engineers .. 514
Literature .. 514
Obituary—
Sir John Kennedy .. 515
Motor Car Exhibition at Olympia and the White City. No. V. (Illustrated.) .. 516
Extended Uses of Rubber .. 519
An Automatic Mechanical Train Controller. (Illustrated.) 520
White Lead in Painting .. 521
Launches and Trial Trips .. 522
Personal and Business Announcements .. 522
Provincial Letters—
The Midlands and Staffordshire .. 522
Lancashire .. 523
Sheffield .. 523
North of England .. 524
Scotland .. 524
Wales and Adjoining Counties .. 525
Latest News from the Provinces .. 525
Catalogues .. 525
Current Prices for Metals and Fuels .. 526
French Engineering Notes .. 527
British Patent Specifications. (Illustrated.) .. 527
Forthcoming Engagements .. 528

DEATHS.

On the 7th November, at The Chantry, Aylesbury, Major Robert Young Thomas, O.B.E., R.E., M. Inst. C.E., County Surveyor of Buckinghamshire, aged 58.

On the 7th November, at 11, Montpelier-square, London, Lieut.-Colonel Pelham G. von Donop, late Royal Engineers and Chief Inspector of Railways, aged 70.

THE ENGINEER.

NOVEMBER 11, 1921.

Science and Industry.

So much has been written of the importance of science to industry that it would seem impossible to deal with the subject again without wearisome reiteration. Yet one aspect of the matter was brought very prominently to the notice of all those who followed the proceedings at the recent meeting of the Institute of Metals in Birmingham. Remarks and announcements made from the chair at the beginning of the meeting suggested that a special effort was to be made to render the work of the Institute more directly useful to its non-scientific and even to its non-technical members. The criticism is sometimes heard from both engineers and metal manufacturers that the papers published and discussed by the Institute, however valuable, are not of a character which is directly useful in everyday industrial life, and it is suggested that this Institute—and other similar institutions—should mend their ways, "come down to earth," and deal with practical matters.

No doubt there is considerable justification for criticism of this kind, at all events from one point of view. These institutions include among their members a considerable number of men who are from unavoidable causes unable to understand and appreciate the more scientific or even the more highly technical papers, and if the institutions desire to retain these members they must provide matter which reaches them at their level of knowledge. If they are to do this they must, however, abandon their present plan of publishing only such papers as contain original matter, and contribute to the advancement—scientific or technical—of their subject. Such papers are inevitably and unavoidably "above the heads" of men who have not had the requisite training. Another type of paper altogether is required to meet the needs of this class—papers dealing not with novel or disputed points, but with comparatively elementary and simple subjects. The highly skilled expert regards these simple elementary matters as unworthy of treatment in the *Journal* of a great Institute, and he is even apt to assume that such things are familiar to *all* its members. This, however, does not appear to be the case, and there are certainly many who join such an institution in the hope or expectation of receiving what is really elementary instruction in regard to the science and technology of their own industry. Once this fact is recognised, there are two alternative courses open to these technico-scientific institutions. They must either continue their present course of dealing with original matter only—a course which undoubtedly serves the purpose of fostering the real advance of knowledge in the branch with which they are concerned better than any other. But they then run the risk of losing the membership of those who are not sufficiently trained to appreciate such papers and whose breadth of outlook is not sufficient to induce them to support the Institute for the benefit of their industry as a whole and apart from immediate and direct personal advantage. If they fear to run this risk, then on the other hand, the institutions must curtail their activities so far as fostering original new work is concerned, and devote a part of their energies and of their very limited financial resources to the publication of papers of an instructional sort which will directly interest and appeal to the type of member in question. No doubt this could be done, and it would serve a very desirable and useful purpose; but, done alone, we may question if it would, in the long run, serve the interests of the industry and of the nation as well as the support and encouragement of really original work. The ideal solution is, of course, that the institutions should endeavour to do both—to foster research and original papers of the most advanced kind, and at the same time to publish lectures or papers dealing with immediate practical matters. The only difficulty lies in the fact that the present immense cost of publication sets a very rigid limit to the scope of the activities of all our technical institutions, so that it would become necessary to curtail original publications if the other kind of work was also to be done.

We may regret, but we are forced to admit, that in this highly specialised age there is real need on the part of our technical institutions for this educational work. I is, for example, irrational to expect naval architects or mechanical engineers to keep abreast with the latest advances of scientific metallurgy or molecular physics. Yet it is desirable in the highest degree that they should know something of these things, and an occasional popular exposition of them could not fail to do good. Every engineer who has made his way in some particular branch of his profession will admit that now and then he has to pick up his text-books and refresh his memory about elementary facts. How much more important is it that he should from time to time be instructed in the broad principles of the collateral branches of his profession, in which he has never received any instruction at all, or with the advances of which he is, from lack of time, unable to keep pace? It may be said that an *ad hoc* society like the Institute of Metals should not require such treatment, but to argue so would be to shut our eyes to the nature of the constitution of that Institute. We must take the institutions as we find them, and admitting that they fall in some measure from perfect grace, we cannot but recognise that even the Institute of Metals would benefit by occasional elementary lectures on the principles of the relatively new science of metals.

Efficiency.

There has never been a time when men and women did not fight against the tyranny of human efficiency. Years ago George Eliot wrote—in "Scenes of Clerical Life"—"Immense improvement! says the well-regulated mind, which unintermittingly rejoices in the New Police, the Tithe Commutation Act, the penny post, and all guarantees of human advancement, and has no moments when conservative reforming intellect takes a nap, while imagination does a little Toryism by the sly, revelling in regret that dear, old, brown, crumbling, picturesque inefficiency is everywhere giving place to spick-and-span, new-painted, new-varnished efficiency, which will yield endless diagrams, plans, elevations, and sections, but, alas! no picture. Mine, I fear, is not a well-regulated mind: it has an occasional tenderness for old abuses; it lingers with a certain fondness over the days of nasal clerks and top-booted parsons, and has a sigh for the departed shades of vulgar errors." Or, again, does not Samuel Butler tell us how the good people of Erewhon decided in solemn conclave on the destruction of all machinery and the punishment of anyone who should venture to introduce modern methods of supplanting the work of men's hands? And to come to the very present, we find Colonel Kitson Clark, an engineer of high standing and the head of a famous firm, saying, "If we assume that what is good for one machine or man is good for all, then the ideal is that every individual machine or man should be expert at one process, and so we arrive at efficiency. But I sometimes wonder if Efficiency, now spelt with a capital E, is really the be-all and end-all of everything; it is a great minister in our modern materialistic life, but its

lines are hard, and its Economics sometimes expensive"; and in another place in the same address to the Institution of Locomotive Engineers, "Men are endeavouring to alter the human, illogical, and kindly constitution of the past, into the direct *ad hoc* organisation that an idealist proposes—and is fortunate enough not to have to practise."

So it has always been and so it will be to the end. There are, we suspect, few, indeed, of our readers in whom the words we have quoted do not touch a responsive chord; few, indeed, who somehow or other, in some way or another, do not endeavour to rid themselves of the Old-man who clings round their neck in their daily affairs and who seek, at least in their leisure, relief by dabbling in antiquities or returning, in themselves, to the ancient ways of the handicraftsman. We may assume, then, that much as men desire to enjoy the fruits of efficiency, they do feel that Efficiency itself is a tyrannical abstraction which by its concrete actions forces them to do things which they do not like to do. It behoves us to think what this means; to consider, as scientists, if we are really achieving complete efficiency as long as we are fostering unease of mind. There is a story told of a visitor to a certain factory where parts are stamped out by the millions from steel plates. The visitor watched for some moments an operator feeding strips of steel into a gigantic machine and then asked him what he was doing. "Punching," replied the man. "What are you punching?" asked the visitor. "X 56," replied the workman. "What is X 56?" said the visitor. "Don't know," said the workman. "What is it for?" inquired the visitor. "Don't know; it's just X 56," was the reply. "How long have you been doing it?" was the last question, and the awful reply, "About twenty years!" That, no doubt was efficiency from the point of view of production. It enabled the manufacturers to turn out vast quantities and to sell machines at a popular price. But was it human efficiency in the large sense? Was it likely to make happy and contented men? It is no exaggeration; the same thing is going on now in thousands of factories, and is extending daily as efficiency methods and mass production increase. Ought we not to ask ourselves if some of the disturbances in the industrial world spring from it; arise from the stultifying effects on men's minds of monotonous repetition of uninteresting work? We may not be able to see how it is to be obviated, we may not be able to see how fierce competition is to be met save by the adoption of these methods; but it is unscientific to close our eyes to the result. We must face it as an actual unpleasant fact, and if we are thorough in our desire for real efficiency—not only workshop efficiency but the production of a happy and contented nation—we must seek means of mitigating, modifying or removing it. But it is not only in the workshops that efficiency is producing a mental state which leaves much to be desired. Let any one do as we have done and inquire amongst the men who are engaged in the direction, organisation, and selling departments of great companies and great "combines," and they will find there also lively discontent. There is no man worth his salt who does not desire to express his own individuality, but in these vast organisations individuality has to give place to system, and with few exceptions the men are units or numbers whose power of self-expression must be surrendered to routine and who must submit to direction and manipulation by an impersonal head, who measures their value by a system of book-keeping and uses or throws them away as it would a machine of brass and iron.

"Men," said Colonel Kitson Clark, "are endeavouring to alter the human, illogical and kindly constitution of the past into the direct *ad hoc* organisation that an idealist proposes—and is fortunate enough not to have to practise." Here we have one manufacturing engineer who feels that there is something wrong with efficiency systems as they now exist, and there are scores more who feel with him. On the workmen's side there is the same feeling. It displays itself in the frequently reiterating demand to have some part in the management of the businesses in which they are employed. In the old days that demand did not exist because the men felt that they really were bound up with the fortunes of the firm. In those days the man engaged on some part of a machine knew what it was for, frequently saw it incorporated in the whole, and heard afterwards of its success or failure. *Esprit de corps* came naturally to workmen in those days; now we try to foster it by artificial means—and fail. The men have no other interest than their weekly pay, and trouble only too often ensues. The "idealist," as Colonel Kitson Clark calls him, does not always see these results. He thinks only of his schedules and card indexes; he is "fortunate enough not to have to practise" his devices, and does not know whither they lead. But the sympathetic, thoughtful employer sees, and he knows that there is something wrong with these ideal plans, that in the search for workshop efficiency we are neglecting human efficiency, and he is troubled thereby.

Institution of Electrical Engineers.

On Thursday evening of last week the new President of the Institution of Electrical Engineers, Mr. J. S. Highfield, delivered his presidential address at the Institution's headquarters. The granting of a Royal Charter, he said, together with the honour conferred upon the Institution by the King becoming a patron, marked a great step forward, and it was essential that the efficiency of the Institution should be more than maintained. Dealing with labour troubles, Mr. Highfield remarked that the trade unions had done much good for their members, but they had also done at least an equal amount of harm, not only to their own people, but to the whole nation, by forcing the adoption of the principle of standard wages and by reducing output. How could any man, he asked, take pleasure in his work under such conditions, and since his life must be passed in work, how could he be happy unless he enjoyed it? In a well-conducted State everyone should have an opportunity to earn a living; but, unfortunately, that happy condition of affairs was not easy to attain.

Since the majority of workers had to work with their hands, the question arose as to whether the present methods of education were correct. The most proficient hand skill and the most useful knowledge of some of the difficult industries, such as farming, shipping, and engineering, were acquired and could only be acquired in boyhood. It was known that the founders of the engineering industry, Watt, Stephenson, Arkwright, Maudslay, Nasmyth, and Faraday, enjoyed the minimum of book education in early years. They spent those years working with their hands, nevertheless struggling to acquire book knowledge, and succeeding. In later days the process had been reversed, and the acquisition of book knowledge had been made easy. Many schools were moving in the opposite direction and were teaching art and hand skill at an early age. That process should be carried further, but it could not be done unless the teachers themselves possessed the necessary skill. Every skilled trade was in itself an art, just as music, painting, and sculpture were arts, and all arts had to be practised at an early age. Besides assisting in the perfecting of art, education had to be directed mainly to the formation of character. Continuity of education should be insisted upon.

Important work had recently been done by electrical firms towards improving the training of their apprentices, and technical assistants and every engineer in a managing position should assist in the education of his men and their sons. One of the nation's most valuable assets was a great body of men skilled in their trades and taking a delight in their skill. It was an asset of greater value than the easily won raw material. There were very few jobs which did not require skill. There were no unskilled trades, but unfortunately there were many unskilled workers. There should be due reward for skill and industry. Many members of the Institution had had wide experience in directing men, and they knew the value of the proper skilled man who loved his work. They also knew the heart-breaking task of directing ignorant and idle labour.

In dealing with the expansion of the electrical business, Mr. Highfield referred to the importance of reducing the cost of transmitting electricity, and pointed out that new methods were required. There was, he said, more water power available in the United Kingdom, and especially in Wales and Scotland, than had been realised, and in that connection the work of the Water Power Resources Committee—consisting largely of members of the Institution of Electrical Engineers—was to be commended. But the fullest uses of those resources depended upon cheap transmission. The cable makers had done much to help in that direction and had succeeded, despite increased costs, in improving the design of cables so as to transmit electricity at a cost little more than that which prevailed before the war. The greater facilities for overhead lines given by the Electricity Act were useful and should, he thought, give opportunities for providing electricity in many districts which could not be served by underground cables. Attention should be directed to the means of connecting the lines to consumers' apparatus, and switchgear and other subsidiary plant should be simplified even at the expense of security, in order to reduce cost. In the past engineers had been very careful to provide a secure supply, but in view of the reduced wealth of the nation they had probably gone too far in that direction. Many manufacturers were content to depend for the running of their mills and works on a single gas or steam engine and to put up with occasional stoppages. Electrical engineers were, however, able to give greater security than that without unnecessary safety devices or an undue amount of spare plant, and there was no sense in trying to provide more security, as there was no money to pay for it.

On the management side of the business there was the important problem of arriving at a satisfactory tariff. It was now generally realised that the tariff should be arranged so that two meters were unnecessary. It was most desirable that the consumers should obtain the benefits of electricity for all purposes without having to pay for double wiring. That necessitated a system of charging which would enable electricity to be supplied for all purposes through a single meter on what was known as the "contract system" or "two-part tariff." The Electrical Development Association had done excellent work in advocating that the two-part tariff should be made a legal one. Progress in electricity supply rested first on a general determination to cease talking and to get to work. It was necessary to depend for guidance on the Electricity Commissioners, who constituted a skilled tribunal in which increasing confidence was being placed. The difficulty of the Commissioners' task was enormously increased by the Act that gave them a constitution. It allowed them too little freedom from political control, and it gave them duties both executive and judicial. That combination of duties necessarily increased their difficulties, and it seemed that they should concentrate on the judicial and advisory side of the work.

The main obstacle to progress was the feeling of uncertainty and insecurity created by the Electricity Supply Bill as first presented. That Bill threatened the existence of every company undertaking and contained admittedly unfair proposals for the purchase of both municipal and company works by new State-aided boards, which were to carry out in all industrial districts the work for which the power companies were established with parliamentary sanction. That feeling of uncertainty still existed in spite of the fact that in the Act as finally passed the objectionable feature was removed. The feeling could only be dissipated by a clear proof that in any scheme the existing rights, both of companies and municipalities, will be respected, and the restoration of confidence by a feeling of certainty that such was the policy of the Commissioners was of first importance. Secondly, the companies and municipalities should realise that they were both charged with the duty of providing the public with electricity and should help each other to supply it in the least expensive way. A third obstacle to progress was the purchase clause in Provisional Orders. The twenty-one years' clause in the Act of 1882 absolutely stopped progress for six years, and the present clause also hampered industry and ought to be revoked unconditionally. No single change, Mr. Highfield stated, would do more to promote enterprise and to enable the public to be supplied with electricity at the least cost. All the technical improvements in sight would not produce the beneficial results that would follow that change. It would enable much obsolete plant to be scrapped which must now be retained. It would give heart to the director who desired to raise more capital and to push forward his business, but who dared not at present raise money on account of the fact that he might be forced to sell the undertaking in the course of a few years. There would not be the very necessary tendency to keep prices as high as possible in order to provide sufficient reserve to purchase new plant to continue the business and to provide for an unknown future. Moreover, the waste consequent upon a change of ownership of a great public business was enormous and resulted in an increase in price of the consumer's current.

Literature.

Entropy as a Tangible Conception. By Engineer-Lieutenant-Commander S. G. Wheeler, R.N. London: Crosby Lockwood and Son. Price 8s. 6d. net.

There are many people who hold strongly to the view that entropy should be regarded simply as a mathematical function, and that any attempt to visualise it as a definite property or quality of matter is bound to make it less rather than more readily understood. This, the mathematician's, outlook on the subject is succinctly expressed in Planck's dictum that "entropy is the logarithm of the probability of a state." Others there are who as stoutly hold that entropy can be conceived of as an entity, as something which exists apart from its expression in mathematical symbols. Whether we are strictly justified in saying that Lieutenant-Commander Wheeler belongs to the second category we have some doubts. His object is to give a tangible conception of entropy without resort to high mathematics, but on close examination it will be found that he does not create a conception of entropy in the absolute, but of an analogue to it behind which entropy, while seemingly brought nearer to our vision, remains really as shadowy as ever. Basing his argument on the classical and somewhat out-of-date conception of molecular matter, he takes temperature to be a function of the velocity of motion of the ultimate particles, and by analogy with kinetic energy introduces and develops the idea of thermal inertia with the object of visualising heat energy as the product of a mass quantity and a velocity quantity. Between two changes of state his thermal inertia clearly represents the product of mass and specific heat, but

at a change of state difficulty arises by reason of the fact that latent heat has to be brought into the picture. He smoothes the way by showing that a simple mechanical analogy exists in which up to a certain point the kinetic energy of a body can increase with the velocity with which it is spinning, and that at this point, without further increase of velocity, the body will re-dispose itself relatively to the axis of spin and increase its moment of inertia and therefore its stock of energy. Latent heat is thus to be identified as representing the increase of energy acquired by a body by virtue of an increase of its thermal inertia consequent upon a re-adjustment of the motion of its particles. From this point onwards, using thermal inertia as his basis, the author proceeds to develop his conception of entropy until he ultimately defines it as "that property of a body which measures its capacity for absorbing or acquiring heat in terms of the awkwardness which it incurs for turning that heat into work." As a general rule we approve of the simplification of physical conceptions and of all efforts made to bring them more readily within the grasp of the mind. In this instance, however, we feel fairly confident that the average student of thermodynamics will find it more difficult to follow the author's conception of entropy than to understand all that is conveyed by its usual definition as $\int \frac{d\,Q}{T}$.

Aggregation and Flow of Solids. Being the Records of an Experimental Study of the Micro-structure and Physical Properties of Solids in Various States of Aggregation, 1900–1921. By Sir GEORGE BEILBY, F.R.S. London: Macmillan and Co., Limited, St. Martin's-street, W.C. 2. Price 20s. net.

THE name of Sir George Beilby is so intimately associated with the conception of the amorphous or vitreous state in metals and in solids generally that a book from his pen bearing upon this subject must naturally arouse great interest. In many ways, this degree of interest is justified by the volume before us, which contains a record of a truly remarkable collection of beautiful and interesting experimental observations. The thirty-six plates of excellent photo-micrographs with which the book is illustrated are some of the finest examples of their kind, and include four excellent reproductions of natural-colour photographs of the surface of polished gold. It would be easy to pick out half a dozen examples of exceptionally interesting observations, and for the skill with which they are illustrated and described there can be nothing but the warmest appreciation.

When, however, we come to consider the book as a reasoned statement of a theoretical conception of a truly fundamental nature, and as an example of sound and scientifically accurate reasoning or marshalling of evidence, disappointment is in store. It may be, of course, that the work was never intended to fill such a *rôle*, but as Beilby is rightly regarded as the father of the whole theory of the existence of metals in an amorphous, vitreous state, it might have been hoped—and even expected—that a record of his work, gathering it up into book form, would have stood as a solid scientific foundation for his theoretical views. As it now stands, its perusal leaves the reader with a considerable amount of doubt in his mind. The evidence itself is beautiful and suggestive, but the reasoning based upon it is less satisfactory. An observation is described as "suggesting" a certain inference, and then—in the next chapter—that same inference, without further evidence, is spoken of as having been "demonstrated" in a previous section.

There can, of course, be no doubt that the "amorphous theory," first put forward by Beilby, has proved eminently fruitful and valuable, but it would seem that its originator depended more upon imaginative insight than upon any wide basis of evidence of the application of rigid methods of reasoning. On this account one might have expected, in such a book as this, a full statement of the case as it stands to-day, largely built up by the work of others, instead of a mere record of the author's own work. It is, indeed, this neglect of the work of others which constitutes the most serious fault of the book. In this spirit the author ignores the very serious objections which have been raised to his theory. They have, indeed, been met by the work of others, but Sir George disregards both the *pros* and the *cons* with equal impartiality. His work must therefore be regarded as merely the record of a series of observations made by him, and not as a general treatise on the subject indicated by the title.

Beyond this general criticism of the whole scope and nature of the book, there are a number of statements and passages in it which are open to serious objection. Thus, in his introduction, the author states that because he had not "time to keep in touch with the application of the results of this study to the current problems of metallurgy . . . the bearing of these observations . . . has been misapprehended or altogether missed by other workers." This undoubtedly suggests that metallurgists have failed to appreciate the author's results, and yet it is due to the work of some of the real leaders of scientific metallurgy, both in England and America, that the value of Beilby's conception has been established and a general theory has been set up on a wide foundation of experimental fact. Furthermore, one or two instances of Sir George Beilby's applications of his own views to metallurgical problems, which are indicated in this book, are unfortunate. Thus, in reference to Figs. 91, 92 and 93, Plates XXIX. and XXX., it is suggested that the structure shown in Fig. 92 and on a larger scale in Fig. 93 represents the result of slip in the ferrite grains with the consequent development of vitreous cementing films between them. Yet every metallurgist will at once recognise this structure as the typical coarse martensite formed when steel—even very mild steel—is quenched from such a temperature as 900 deg. Cent. But the amazing statement is this, that the formation of this structure is due to the shrinkage of a carburised "case" existing on the exterior of the bar, and that in the absence of such a case and its resultant supposed shrinkage stresses, the quenched mild steel shows no such internal structure. It is, indeed, surprising to find so good an observer as Sir George Beilby misled into such a statement and such an explanation. Almost equally remarkable, in view of existing knowledge, is the explanation of "fatigue failure" put forward by the author. Largely ignoring—although he does just mention it—the work of Ewing and Humfrey, the author suggests that on each surface of internal slip an amorphous layer will be formed. So far, so good. But the further suggestion that such layers, on each of two adjacent slip surfaces, will gradually grow in thickness until they meet, and that when this occurs a crack must result, appears to be mere speculation. There is, indeed, every reason to think that if two such layers did meet, they would form a particularly strong and rigid place in the crystal, and further slip would occur elsewhere. Ewing and Humfrey showed how the *débris* resulting from repeated slipping backward and forward is forced out upon the surface, and this view of the formation of the fatigue crack is really in much better accord with Beilby's fundamental conceptions.

Further examples might be cited, in other directions, of failure to assimilate the results of more recent work. The whole concept of the molecular structure of solids upon which so much of Beilby's hypotheses are based requires serious modification in the light of the X-ray analysis of crystals and the newer knowledge concerning the structure of the atom and the nature of inter-atomic linkage. Perhaps it is too much to expect such a re-modelling of an investigator's mental pictures, but, unfortunately, its absence leaves the reader who is well acquainted with modern metallurgical and physical ideas dissatisfied. One cannot but read this book with pleasure and interest, and with admiration for the experimental skill of its author, but there was room and opportunity for a really great book on this subject, and since there is no one better fitted to write it than Sir George Beilby, it is impossible not to regret his failure to seize the opportunity.

SHORT NOTICES.

Petroleum. Prepared jointly with H.M. Petroleum Department with the co-operation of H. B. Cronshaw. Price 5s. net. London: John Murray. 1921.—*Silver Ores.* By H. B. Cronshaw. With a map and two diagrams. Price 6s. net. London: John Murray. 1921.—These are two of the monographs on mineral resources, prepared by the Imperial Institute. Previous issues deal with manganese, tin, tungsten, coal, the platinum metals, lead, and chromium. Others treating of potash, copper, molybdenum, vanadium, mercury, oil shales, zinc, &c., are in preparation. They are designed in amplification and extension of those which have appeared in the *Bulletin* of the Imperial Institute during the past fifteen years, and give a general account of the occurrences and commercial utilisation of the more important minerals, particularly in the British Empire. No attempt has been made to include details of mining or metallurgical processes, but a brief reference to reported observations of the existence of oil and silver, and summarised accounts of worked districts and important mines are given, supplemented by the latest available statistics. In 1920 the United States of America produced 65 per cent. and Mexico 23 per cent. of the world's outturn of petroleum Those countries also were accountable for about one-third each of the total output of silver in 1918, as against one-fifth for the British Empire.

Material Handling Cyclopedia. Edited by Roy V. Wright and J. G. Little. New York: The Simmons-Boardman Publishing Company. 10 dols.—Some idea of the extent to which America has pushed the rapid handling of materials may be gathered from this volume, which covers some 850 pages and includes 1500 illustrations. As a guide to conveyors and to the uses to which they have been put it appears to be exhaustive. In one case, for instance, there is a conveyor on which men stand and sew up sacks of fertilisers as they travel along to the storage. It is not explained, however, what happens at the end of the conveyor if the man has not finished his job in time. The book is divided up into three sections, the first of which is a sort of technical dictionary and, naturally, contains principally American terms. The middle section of the volume gives brief illustrated descriptions of practically every type of handling machinery which has been put to work in America. The last, or catalogue, section is virtually advertising matter.

A New Policy for Labour. By Hilderic Cousens. London: Cecil Palmer. 1921. Price 5s. net.—We are reminded by this small volume of the showman who bangs a drum on the platform before a booth and invites the public to enter by the exhibition of enough of his wares to excite curiosity. The object of the author—he makes no secret of it—is to induce people to read Mr. C. H. Douglas' "Economic Democracy," and with that end in view he whets our appetite up to the very point when we believe he is going to reveal the secret, and then suddenly breaks off. That seems to us indecent; it is the sort of thing that ought to be left to handbills or catalogues. We resent it almost as much as an advertisement which looks like a story. We are tempted to believe Mr. Cousens is not an economist at all, but an advertising agent or a publicity manager of the Calisthenes type. It is no palliation of his offence that he *does* actually make us want to read Major Douglas' book to find out the details of his scheme for the establishment of banks by trades unions and the overthrow of the present financial system. We are annoyed with him for luring us on and disappointing us; we are particularly annoyed with him because his chapter on Production gave us furiously to think; we are annoyed with him for interesting us at all; and we shall certainly not buy Major Douglas' book—if we can defeat our inquisitiveness.

BOOKS RECEIVED.

Drawing Room Practice. By F. A. Stanley. London: McGraw-Hill Book Company, 6 and 8, Bouverie-street, E.C. 4. Price 15s. net.

The Practice of Electrical Wiring. By D. S. Munro. London: "The Electrical Review," Limited, 4, Ludgate-hill, E.C. 4. Price 5s. net.

Oil Firing: Its Efficient Application. By E. C. Bowden-Smith. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2.

The Human Factor in Business. By B. Seebohm Rowntree. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 6s. net.

Practical Electricity. By W. E. Ayrton, F.R.S., and T. Mather, F.R.S. New edition. London: Cassell and Co., Limited, La Belle Sauvage, E.C. 4. Price 15s. net.

The Westinghouse Air Brake: A Description of the System and Its Working. London: The Locomotive Publishing Company, Limited, 3, Amen-corner, E.C. 4 Price 2s. 6d. net.

Columns: A Treatise on the Strength and Design of Long Compression Members. By E. H. Salmon. London: Oxford Technical Publications, 1 and 2, Bedford-street, W.C. 2. Price 31s. 6d. net.

Factory Administration in Practice: Organisation and Administration from the Factory Standpoint. By W. J. Hiscox. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 8s. 6d. net.

The Transition Spiral and its Introduction to Railway Curves, with Field Exercises in Construction and Alignment. By A. L. Higgins. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 6s. net.

Engineering Steels: An Exposition of the Properties of Steel for Engineers and Users to Secure Economy in Working and Efficiency of Result. By Leslie Aitchison, D.Met. London: Macdonald and Evans, 29, Essex-street, W.C. 2 Price 25s. net.

Aluminium and its Alloys: Their Properties, Thermal Treatment and Industrial Application. By C Grard. Translated by C. M. Phillips and H. W. L. Phillips. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 17s. 6d. net.

Ministry of Munitions and Department of Scientific and Industrial Research: Technical Records of Explosives Supply. 1915–1918—*No. 2, Manufacture of Trinitrotoluene (T.N.T.).* London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 17s. 6d. net.

Obituary.

SIR JOHN KENNEDY.

THE death of Sir John Kennedy, consulting engineer of the Montreal Harbour Commissioners, occurred in that city on October 25th. Sir John, who had reached the advanced age of eighty-three years, was born at Spencerville, Ontario, and graduated at McGill University, Montreal. After filling a number of important positions he was eventually appointed chief engineer of the Montreal Harbour Commission in 1875, a position which he held for thirty-three years, in the course of which he effected many important improvements in the facilities of the port, one of the most beneficial of which was the prevention of floods due to the accumulation of ice in the river. For eighteen years he was also chief engineer of the St. Lawrence ship channel between Montreal and Quebec, the deepening of which was carried out under his direction. During his earlier career he was the first engineer to lay a double-track railway in Canada, the line running between Windsor and Glencoe, in Ontario.

Sir John became blind in 1907, but despite his affliction retained his connection with Montreal Harbour Commission, becoming consulting engineer, in which capacity he continued to render important services. In recognition of his work he received the honour of knighthood from the Imperial Government on New Year's Day, 1916, while in 1917 the honorary degree of LL.D. was conferred upon him by McGill University, and in 1921 the McMaster University of Toronto bestowed on him the degree of D.C.L. Sir John was a member of the Institution of Civil Engineers, of which for some time he sat on the Council, and a member of the American Society of Civil Engineers. He was one of the founders of the Canadian Society of Civil Engineers, and was chosen president of that body in 1892.

Motor Car Exhibition at Olympia and the White City.

No. II.*

Owing to the large number of applications for space, the promoters of the motor car show were again compelled to make use of the two great places of entertainment, Olympia and the White City, a fact which calls attention to the urgent need of a single site for such functions in or near the Metropolis. Unfortunately, the site on which Olympia is built is hemmed in all round by "bricks and mortar," which would seem to preclude extension. On the other hand, at the White City there is a large area of land available on which suitable buildings capable of holding such exhibitions could be erected. The present arrangement, which involves travelling backwards and forwards between the two sections of the exhibition, is very tiring for visitors and unsatisfactory to the exhibitors, for a very large percentage of the visitors probably never see both sections. According to the preface to the voluminous catalogue, there are altogether 571 exhibitors this year, an increase of 52 compared with last year, which constituted a record entry, and with the exception of late enemy countries the whole is thoroughly international. Writing from memory, there are only two really important absentees in the car section, one an American and the other a British firm. The inclusion in the catalogue of the prices of the car exhibits is a great advantage to prospective purchasers, who are at once able to compare the cost of the various makes along with their chief features. The general arrangement of the exhibition is, however, not so satisfactory, and we would suggest that in future shows it would be a great boon to the public if a system of grouping in accordance with prices could be adopted. At the present time we have frequently on one stand cars varying in price between, say, £2000 and £200. Among the higher-priced vehicles there is little really new to report, except in the matter of details; but among the lower-priced machines, say, between £200 and £350, there are many exhibits of novelty to be seen, for which there will have to be an unprecedented demand if all their makers are to be kept fully employed during the next twelve months. Considering the present high prices of materials and labour, several of these small cars represent really good value for money. We shall refer to some of these later. As was only to be expected, there is a marked improvement in body building and fittings compared with the last two shows, and the coachbuilders' art seems to have been restored to its pre-war standard of quality. Neither steam nor electricity as a source of motive power seems to be making any headway for pleasure vehicles, for there is only one example of each on view, and neither of these is new. Quite a feature of the small car section is the number of cars fitted with twin-cylinder horizontal engines—a type of motor which recalls some of the earliest efforts in motor vehicle propulsion. It seems like history repeating itself to find one of the most important firms in the country—namely, Wolseleys—reverting to its earliest practice in this respect. It is very questionable whether this is the right direction in which to cheapen production—presumably the object of the designers. Air-cooled engines are still rigorously confined to the smaller vehicles and result in a considerable saving of weight. The motor cycle has, of course, done much to popularise this type of engine and to remove the prejudice on the part of motor car owners to its adoption. It has been thoroughly tested during the past year and has demonstrated its reliability when properly handled. There is still a desire on the part of some small car builders to get rid of the change-speed gear-box with its sliding gears, by employing friction drive mechanism, and in one case by the use of a countershaft and a series of chains and clutches; but there is as yet no serious rival to the gear-box. The introduction of air-hardening steels has been the means of perpetuating its use to a considerable degree, and it is remarkable how small present-day gear-boxes are compared with those of former years.

Quite the most popular type of engine still is the four-cylinder, with valves side by side, but the overhead valve is creeping up. There are a few newcomers in the sleeve valve type of engine, and detachable cylinder heads also tend to increase. With regard to clutches, the multiplate form outnumbers any other type, and for the final transmission the spiral bevel has made a very rapid advance. It appears likely to supersede the straight bevel entirely in the not far distant future. Worm gearing for this purpose seems to be making little or no headway in spite of its quietude and silkiness. The final chain drive is now only used for a few of the very light cars. In the matter of suspension there is much diversity of design, but the cantilever principle is more extensively used for the rear springs than ever before.

Amongst the new models shown for the first time at Olympia is the 14 horse-power Vauxhall, illustrations of which are given in Figs. 4 and 6. It is not a copy of the larger model by the same firm, from the design of which it differs in essential features. The engine has four cylinders cast monobloc, 75 mm. bore by 130 mm. stroke, and the R.A.C. rating is 13.9 horse-power. Side valves, aluminium detachable cylinder head, a special form of combustion chamber, and an exhaust heated induction pipe are features of this neatly designed engine. In order to keep the heat of the exhaust away from the footboards the exhaust pipe is carried down to the silencer at the front end of the engine. The pistons are of aluminium alloy and the engine starter is neatly housed in the rear of the crank chamber casting. Three-point suspension of the engine and gear-box, which form one unit, is adopted, the front end of the engine being supported on a trunnion. Ignition is by high-tension magneto and variable spark. The lubrication is under pressure supplied by a plunger pump. For cleaning the lubricating oil a barrel type oil filter is provided, the gauze of which is easily removable for cleaning. The fan for cooling purposes and the water pump are one unit on the cylinder head. The clutch is of the single plate pattern, and the gear-box has three forward and one reverse speeds, the gear ratios being 4 to 1 on the top, 6.75 to 1 on the first, 14 to 1 on the second, and 23.8 to 1 on the third gear. A hollow tubular propeller shaft with a universal joint at the front end is provided, and the torque is taken up by a tube which encloses the shaft. Spiral bevel gearing is used for the final drive. The main frame is of deep channel section upswept at the rear. The main springs are semi-elliptic at the front and of the cantilever type at the rear. The cantilever springs are attached to the extreme ends of the back axle. The shape of the radiator and bonnet is that which is familiar on the larger-powered car. The road wheels are of the detachable disc type and the tires 815 mm. by 105 mm., the wheel base being 9ft. 6in.; both foot and hand brakes operate on the rear hubs.

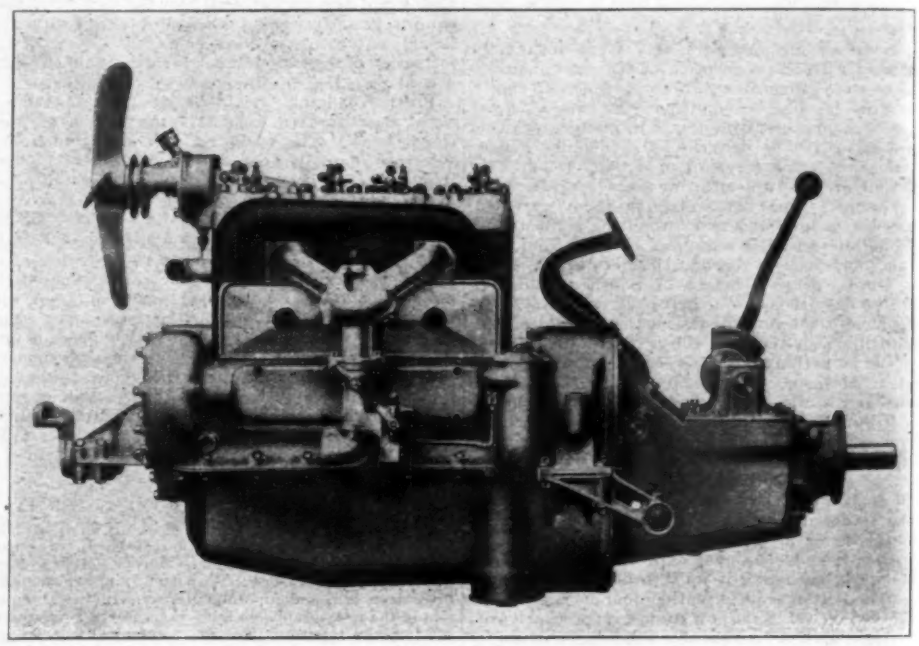


FIG. 4—14 HORSE-POWER VAUXHALL ENGINE AND GEAR BOX

The Sunbeam Motor Car Company, Limited, is also introducing a smaller car next year, namely, one of 14 horse-power, specially adapted to the needs of the owner-driver, its chief features being simplicity and economy in operation. Views of the chassis shown at Olympia and details are given in Figs. 7 to 10. The engine has four cylinders, 72 mm. bore by 120 mm. stroke, with a Treasury rating of 12.8 horse-power. The cylinder casting is of aluminium with steel liners, offset from the crank shaft and a detachable head is provided. Complete with manifolds and dynamo the engine weighs 322 lb. and develops 40 horse-power at 2800 revolutions per minute. The valves are of the overhead type, tulip shaped, and situated side by side on the detachable cylinder head. They are operated by overhead rocker arms and vertical push rods, driven by ball-headed tappets bearing direct on the cam shaft. The valve springs consist of flat coils telescoping into each other, the spring being used to lock the valve cup to the stem. The rocker arms are bushed and pivoted on a tubular shaft secured to the detachable head by means of studs passing through stanchions. The arms are drilled through their centres and grooved on their upper side to receive oil, which is allowed to drip on to the operating gear from an overhead copper tube running the full length of the cylinder casting and supplied with oil from a pump. The crank case is of aluminium, the upper half being cast integrally with the cylinder block. The cam shaft is a nickel-chrome forging driven by a silent chain from the crank shaft, and the latter is a 40-ton steel forging, drilled for lightness and oil circulation. It is carried in four white metal bearings. The pistons are of aluminium alloy with a flat crown. They have each three gas rings and a scraper ring. Coil ignition with an automatically controlled spark advancer and distributor is fitted. The induction pipe is exhaust heated and the lubrication forced by a gear-wheel pump to the main bearings. The cam shaft is oiled by splash and the valve gearing by drip feed by means of a low-pressure lead from the main oil gallery. The cooling is effected by honeycomb radiator and fan. The electric starting motor is placed in a housing cast integrally with the crank case, and the dynamo is driven direct by a belt from the cam shaft. The clutch is of the single plate type with fabric-lined friction surfaces. It has easy means of adjustment and lubrication. Unit construction is adopted for the engine and gear-box. The gear-box contains three forward speeds and a reverse, all shafts running in ball bearings. The gears are lubricated by oil and a pillar spout situated at a certain level prevents overfilling. The gear-box is very small and compact and the speedometer is gear driven from the rear end of the box. A departure from Sunbeam practice has been made in the construction of the rear axle and its transmission. There is an enclosed propeller shaft. At the back of the gear-box is a housing for a large hollow sphere which forms the forward anchorage of the torque tube. Inside this sphere is a universal ring with cast iron floating bushes, capped to retain the oil which is fed to it through holes drilled in the lower side of the partition between the gear-box and spherical casing. The rear axle is formed of two steel pressings welded together and the final drive is by helical bevel gears, the differential gear being also of the bevel type. These gears are assembled in an aluminium housing which can be withdrawn at the back of the axle casing. The front axle is an H-section forging with the thrust of the swivels arranged underneath the axle. The springs are semi-elliptic in front and offset and the rear springs are of the cantilever pattern, all of good length and practically flat under normal loading. Both hand and foot brakes are of the internal expanding pattern and operate in one large aluminium drum on the rear wheels. The drum is lined with cast iron rubbing parts. There is nothing of special significance about the steering gear. The wheels are detachable and of the cast steel type fitted with 815 mm. by 105 mm. tires.

The Rolls-Royce exhibits do not reveal any material alterations in the standard feature of the motive mechanism. We are told that improvements of a minor character are being continually effected, the chief of which lies in the use of improved material. Lighter pistons and connecting-rods, for instance, have been adopted, and the average horse-power has been increased. It is in connection with body work that this firm seems to be able to show much originality in design and construction, and the three types of body at Olympia leave nothing to be desired in the way of luxury. There are a Pullman limousine, a landaulet, and an open four-seater, all of which are perfect specimens of the coachbuilder's craft. The exhibits of the Napier Company, too, contain practically nothing of novelty in connection with the engineering side. This car has established for itself a high reputation for sweetness of running and sound workmanship, such as one expects from a six-cylinder machine, with many years of experience on the part of the builders. The centre of attraction of the Napier stand is a town landaulette. The body is divided into two, the driver's, or front seat, being separate from the main body of the carriage, the latter being arranged on "C" springs, reminding one of the State coach of Victorian days. These springs, in addition to the usual comfortable and flexible cantilever

* No. I. appeared November 4th.

EXHIBITS AT THE MOTOR SHOW

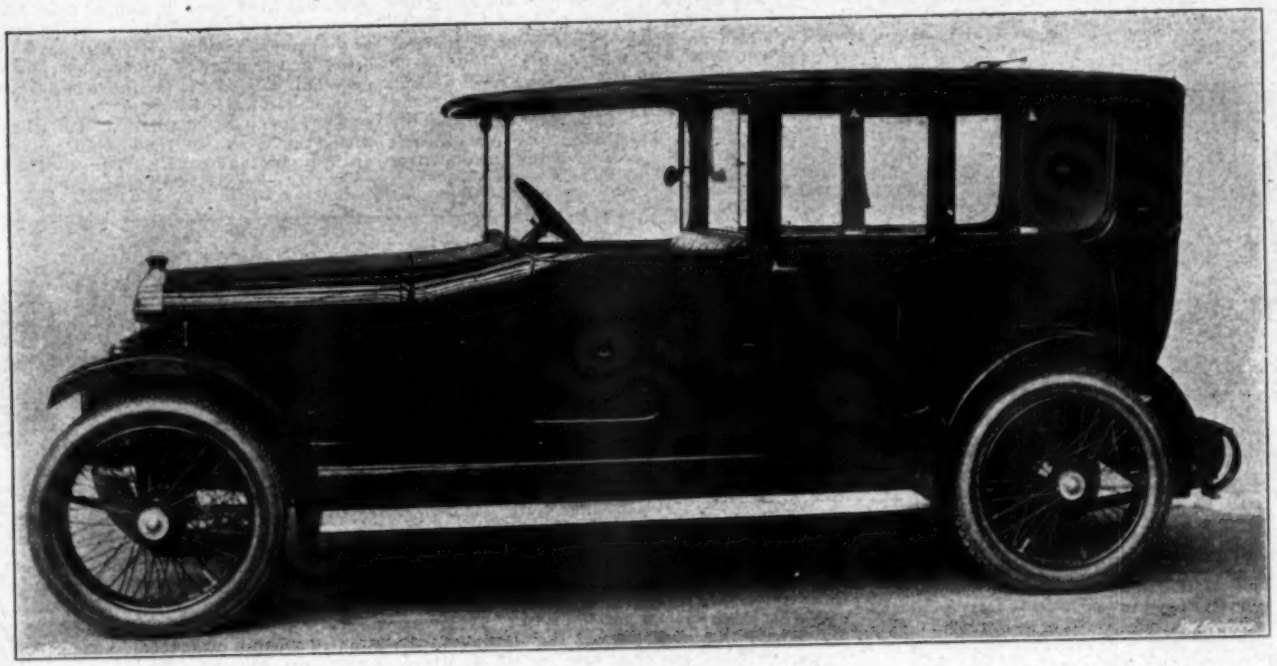


FIG. 5—THE DAIMLER "TWENTY" LANDAULETTE

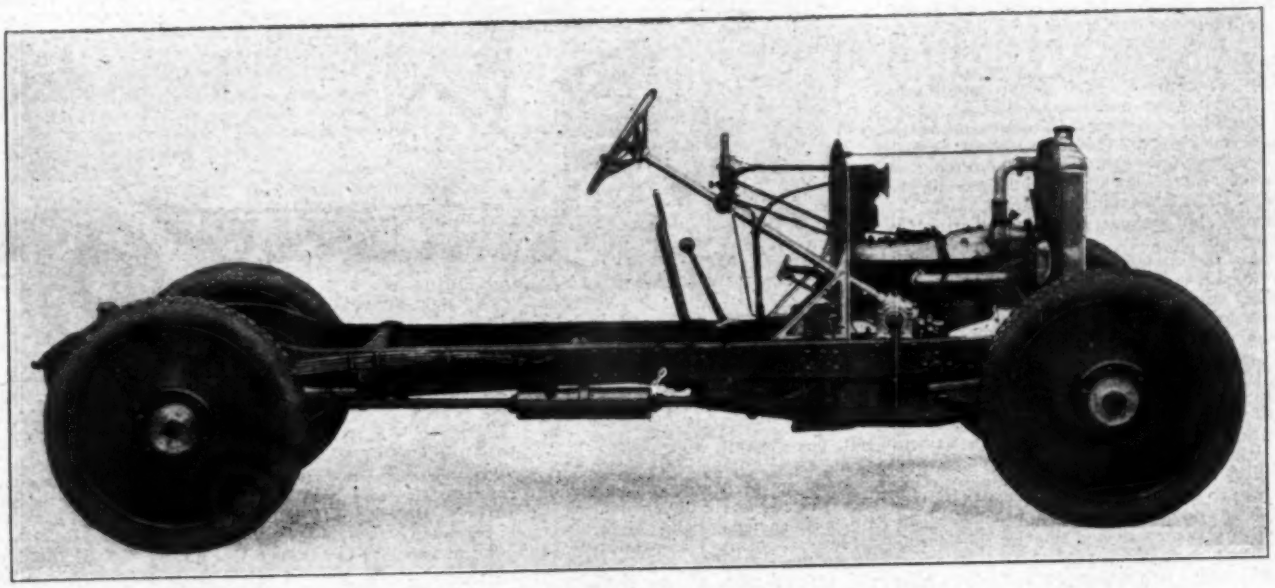


FIG. 6—14 HORSE-POWER "M" TYPE VAUXHALL CHASSIS

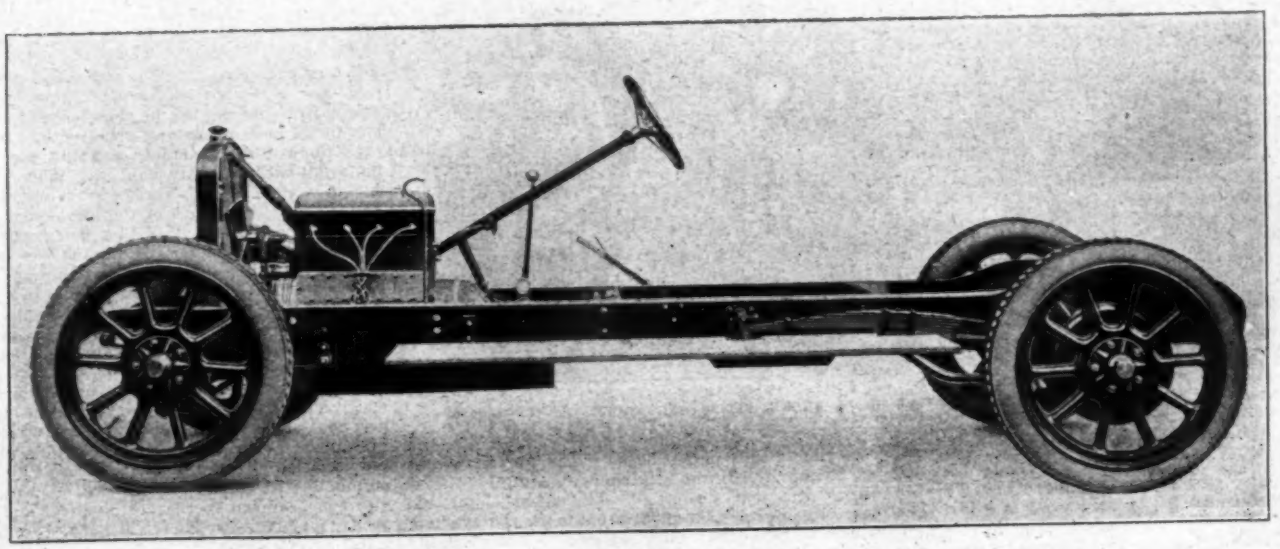


FIG. 7—14 HORSE-POWER SUNBEAM CHASSIS

springing of the six-cylinder Napier, give to the occupants ease of riding over the worst roads. The main body is built to seat two, the seats being arranged in the most luxurious manner in the form of a divan with loose down cushions. The back half of the car is made to open, giving all the advantages of a landaulette. A noticeable feature of this car is the canopy

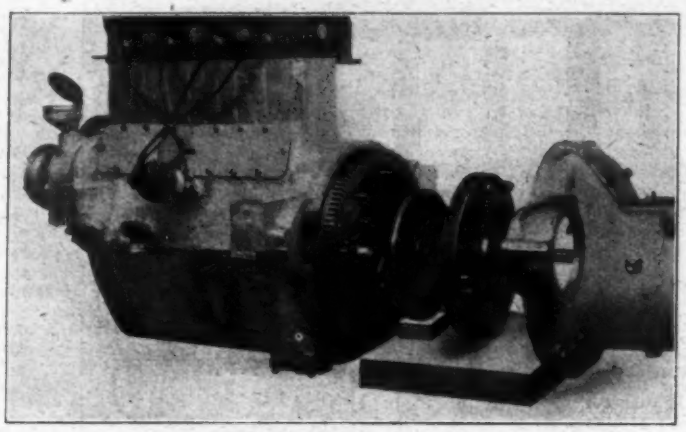


FIG. 8—SUNBEAM ENGINE AND CLUTCH DETAILS

over the driver, which is made on the roller blind principle and simple to operate.

The Armstrong-Siddeley car shown for the first time last year has been a pronounced success, and, encouraged by this fact, the company this year is introducing another car of identically similar design but of smaller power. The six-cylinder engine of this new model has a bore and stroke of 2.73in. by 4.125in. —69.5 mm. by 104.8 mm.—which gives it a Treasury rating for taxation of 17.9. The overhead valve gear is completely enclosed and yet readily accessible, operating continuously under pressure lubrication. Ignition is by magneto, and in order to secure the utmost efficiency and smoothness of running a dual Claudel Hobson carburetter of a special type is provided. Electric lighting and engine starting equipment are included, and a special feature exists in the noiseless and shockless drive of the starter. Grease cups and oilers have been eliminated and are replaced by an ingenious system which is not only exceedingly efficient in ensuring that lubricant shall reach the parts requiring it, but also enables periodical attention in this respect to be given in a minimum of time without soiling the operator's hands. The engine is built up of two three-cylinder castings with aluminium water jacket, covers, overhead valves, magneto ignition, and completely enclosed valve gear. The gear-box and rear axle are made in one unit, the gear-box in the centre of the chassis being attached by a torque tube to the rear axle. The final drive is by spiral bevel gearing. The gear ratios are 4.7 to 1 on the top, 7.82 to 1 on the second, and 16.65 to 1 on the first gear. Semi-elliptical springs on the front and cantilever springs with adjustable shackles on the rear are provided. Two independent internal brakes acting in drums integral with the rear disc wheels are used. The frame is of special design, with very deep side members and step boards riveted thereto, thus ensuring rigidity.

A new and smaller powered model has been added

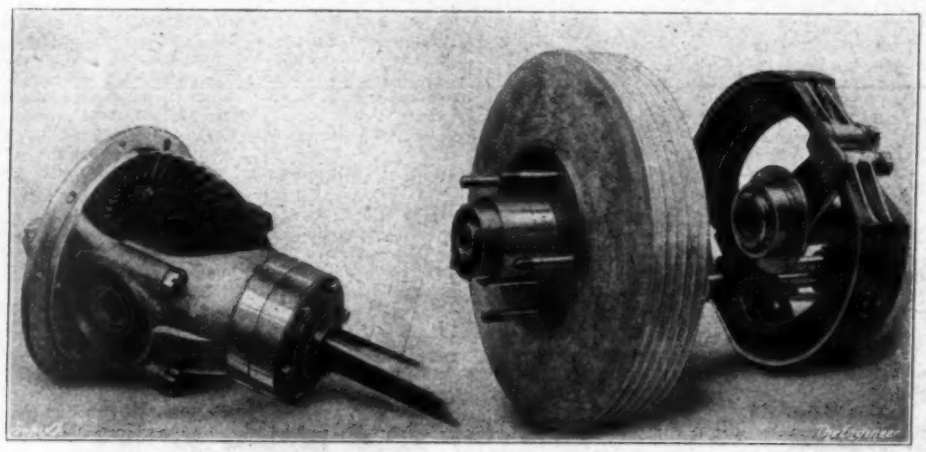


FIG. 10—SUNBEAM DIFFERENTIAL GEAR, BRAKE BLOCK AND SHOE

to the range of cars built by the Daimler Company, Limited, Coventry. This is a 20 horse-power car with a four-cylinder sleeve valve engine. Views of the car and chassis are given in Figs. 5 and 11. The dimensions of the cylinders are 90 mm. by 130 mm. and the Treasury rating 20.08 horse-power. The engine has high-tension magneto ignition, lubrication by means of a multi-plunger oil pump, with variable throw controlled by the throttle. The clutch is of the single disc type with Ferodo linings. The gear-box has four speeds and a reverse, and the final drive is through underslung Lanchester worm gearing. There are two flexible couplings between the clutch and gear-box, a sliding universal joint behind the gear-box, and a universal joint in front of the rear axle. All the bearings in the gear-box are of the ball type. The torque and drive are taken through the springs, the rear springs being of the three-quarter

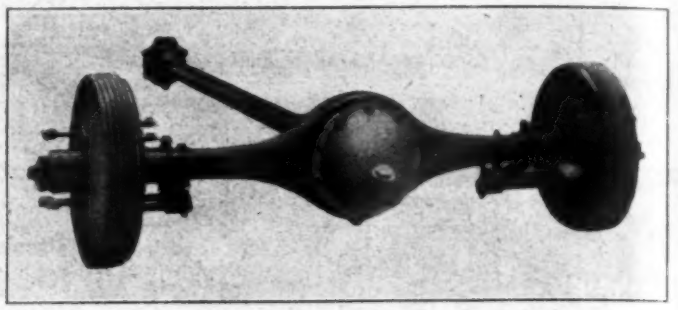


FIG. 9—SUNBEAM REAR AXLE

elliptic type and on the front the semi-elliptic pattern. The dynamo of the Rotax type is driven off the engine by a simple adjustable belt, and the electric starter operates through gears on a ring on the fly-wheel. The principal dimensions of this vehicle are:—Wheel base, 11ft.; wheel track, 4ft. 9½in.; overall length, 15ft. 6in.; overall width, 5ft. 8½in.; and the turning circle, 43ft.

Amongst the new light cars exhibited perhaps the most original is the 9 horse-power Belsize with the oil-cooled engine designed by Mr. Granville Bradshaw. It has a roomy two-seater body and the chassis weighs less than 8 cwt. A view of this car is given in Fig. 12. The engine is a two-cylinder "V" type with

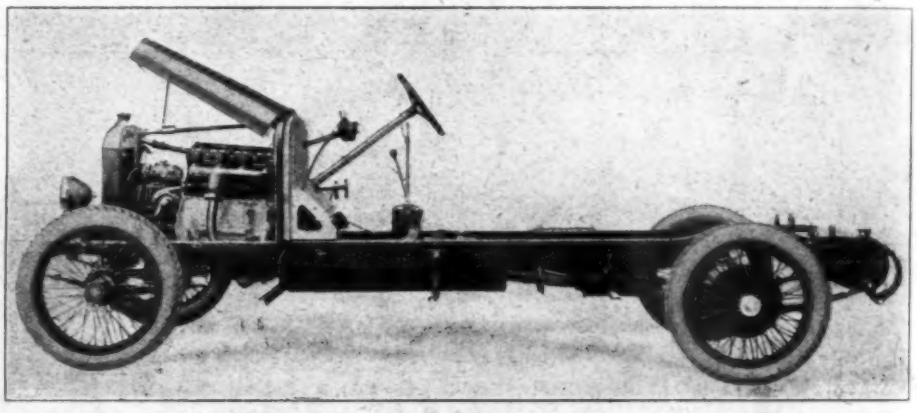


FIG. 11—CHASSIS OF DAIMLER "TWENTY"

the cylinders disposed at 90 deg. The bore and stroke are 85 mm. by 121 mm., the capacity being 1370 cubic centimetres, and the tax £9. The engine, clutch and gear-box are self-contained in one unit, the whole of which is completely enclosed and is automatically lubricated without attention of any sort. There are no external working parts except the fly-wheel, and even the valve springs, tappets, &c., are situated within the crank case and are automatically lubricated. The makers claim that the new system of cooling is remarkable for its efficiency. The cylinder barrels are sunk into the crank case, and the heat is extracted from them as well as from the pistons by means of a constant and large circulation of oil, which at the same time eliminates the unpleasant clatter that arises in the average air-cooled engine owing to the metallic noise that is produced in the cylinder. The cylinder head is made of an aluminium die casting and is separately cooled by a fan which is formed within the fly-wheel. The lubrication is entirely automatic by an oil circulating pump. The oil is forced under pressure through the crank shaft to the connecting-rod big-end bearings, thence it is spread in large quantities over the cylinder barrels, pistons, valve gears, &c., from which parts it collects the heat and conveys this heat to the walls of the exceptionally large crank case, from which the heat is subsequently radiated to the atmosphere. The whole of the oil is carried in the crank case sump and the gear-box, and a pressure gauge is fitted to the dash-board to indicate when the oil is too low. Under most strenuous tests on the bench, we are told, the temperature of the oil does not exceed that of boiling water. An efficient oil filter is situated in the base of the crank case, which can readily be removed for cleaning purposes. The crank shaft is exceptionally stiff, having only one throw, the two connecting-rods which are of exceptionally large dimensions in their bearings being carried side by side on the same crank pin. The big-end bearings are of white metal, die cast, and are readily adjustable for wear. The standard pistons are of cast iron designed to conform to the requirements of oil cooling. They are fitted with two ordinary piston rings at the top and a special chamfered ring at the bottom for the purpose of preventing the oil from passing up the cylinder walls. The gear-box forms part of the unit construction, but is separately bolted to the crank case and can readily be removed without disturbing the mounting of the engine in the chassis. Three speeds and reverse gear are provided, the whole of the mechanism, including the selectors, within this box being automatically lubricated by the engine. The clutch is of the multiple plate variety, but the friction surfaces are extremely lightly loaded, thereby preventing any risk of damage even with excessive slipping of the clutch. A clutch stop is fitted which enables an excellent gear change to be made without any previous experience. This clutch stop is a very powerful one, but is not stationary as in ordinary practice. It is carried on a member which is positively driven from the cardan shaft; thus it is constantly rotating at car speed and it is impossible to over-slow the clutch; therefore, in all gears the variation of speed of the teeth is well within that permissible for direct engagement. When changing into top gear the speeds are identical and the gear change is silent every time. The final drive is through spiral bevel gearing.

Another completely new car exhibited is the 10 horse-power B.S.A., an illustration of which is given in Fig. 13. This car has an air-cooled twin-cylinder

engine of the 90 deg. "V" pattern, and the cylinder dimensions are 89.75 mm. bore by 85 mm. stroke. The body is designed to carry two adults, but there is room for a third in emergency, the front seat being 2ft. 6in. wide, and there is a dickey seat at the back. We propose to give further particulars of the mechanical features of this car in our next issue.

Four types of Ruston-Hornsby cars are on view at Olympia, two being fitted with 16–20 horse-power engines and two with 20–25 horse-power engines. The main features of these cars have not been altered since last year. Both types have four-cylinder engines, centrally controlled three-speed gear-boxes, fabric-faced cone clutches, and spiral bevel drive. Hand and foot brakes operate through large expanding shoes on the rear hub drums and the three-quarter elliptic

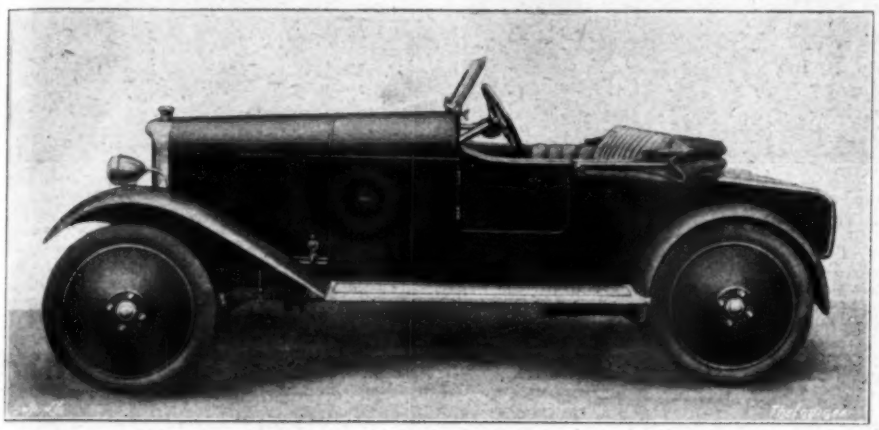


FIG. 12—9-H.P. BRADSHAW-BELSIZE CAR

underslung rear springs are of sufficient length to ensure a very commendable degree of comfort. Semi-elliptics are fitted in front and the Marles self-centring steering gear, which has given such excellent results during the past two seasons, is common to both models. The smaller car has an engine of 80 mm. bore and 130 mm. stroke, and the 20–25 horse-power a bore of 90 mm. and the same piston travel. Features of the standard body work are the concealed hood on the open examples of the larger type, and on all touring models, the adjustable front seats, which can be altered to give the desired leg room by simply lifting a catch and sliding the seat backwards or forwards on runners. Commodious lockers are provided behind the valances on both sides for storing spare petrol and oil tins, &c.

The results of last year have satisfied the Humber Company with the chief features of the models on which it is concentrating its attention. These are two 11.4 horse-power models and two 15.9 horse-power models. The 11.4 horse-power models have four-cylinder engines, 68 mm. bore by 120 mm. stroke, and the cylinders have detachable heads. Four forward speeds are provided and the final drive is by bevel gears, for which there is special adjustment. The 15.9 horse-power models have four cylinders, 80 mm. bore by 149 mm. stroke. There are four speeds and the final transmission is by means of bevel gears. The workmanship put into the Humber cars will always bear close inspection, and this remark applies in a special degree to the coach-building work, which is very sound. In the 15.9 horse-power car for next year a specially designed folding apron or lid is provided to protect the rear passengers, and on this lid are fitted removable glass screens, which effectually prevent unpleasant draughts.

In the small car section another newcomer called the "Wolseley Seven" should be mentioned. In this car the engine is of the horizontally opposed twin type, water cooled, with a bore and stroke of 3¼in. by 3¼in. Cooling is by thermo-syphon through a honeycomb radiator with an inlet and outlet pipe for each cylinder. The cylinders have detachable heads and side-by-side valves, which, together with their springs and tappets, are enclosed by light covers. The pistons are of aluminium alloy and dome shaped. Lubrication is automatic under pressure from a pump driven by the motor with an indicator on the dashboard. High-tension ignition by means of a battery and coil is provided. The gear-box is bolted to the crank case, thus forming a unit with the engine, and provides three speeds and reverse, a selector gate change being used. If desired, an electric starter can be added. Final drive is by a propeller shaft with flexible fabric joints to a spiral bevel-driven axle. The frame members are of channel steel, braced at both ends, the rearward member being formed as an arch. Quarter elliptic suspension is used all round, with a torque spring link over the rear suspension. The wheels are detachable, and fitted with 26in. by 3in. tires. Two independent brakes are fitted, actuated respectively by pedal and hand lever. All hubs run on Timken compound taper roller bearings. Electric lighting equipment is included in the specification, the lamps being mounted on the front mudguards. The engine is rated at 8.5 horse-power.

There is not much that is new in connection with the Lanchester cars, but we noted that a larger radiator is now being fitted, and that a simple thermostatic device has been adopted for controlling the flow of water between the cylinder jackets and the radiator in accordance with the temperature of the water. This comprises a valve in the water pipe, which opens or closes more or less by expansion or contraction. We noted, too, that the magneto is worm driven from the vertical shaft which operates the overhead valves. The Lanchester engine has six cylinders, 4in. bore by 5in. stroke, and gives 38.4 horse-power R.A.C. rating. The well-known epicyclic gear and worm driven axle are still employed, as also is the cantilever spring suspension.

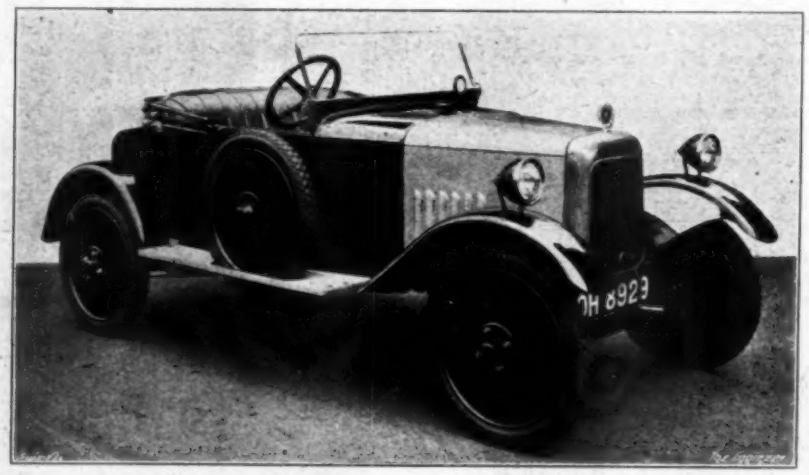


FIG. 13—10-H.P. B.S.A. CAR

Our New York contemporary, the *Railway Age*, has drawn attention to the fact that in July of this year 30 steam locomotives were exported from the United States, as compared with 134 in July, 1920, and that for the seven months ended July 31st 692 were exported in 1921, as against 1025 in 1920. For the same seven months 5579 goods wagons were exported, as compared with 13,708 in 1920.

Extended Uses of Rubber.

In July, 1920, the Rubber Growers' Association offered the following awards for ideas and suggestions for extending the present uses, or for encouraging new uses of rubber:—One prize of £1000; three prizes of £500 each; ten prizes of £100 each; and a sum not exceeding £1500 to be divided amongst the remaining competitors whose suggestions were considered to be of value, according to the relative value of their suggestions, but so that no competitor would receive more than £100. The competition, which was open to the whole world, closed at the end of last year.

The judges appointed were:—Mr. Alexander Johnston, managing director of the North British Rubber Company and chairman of the Research Association of British Rubber and Tyre Manufacturers; Mr. H. J. Glascodine, head of the technical and patents department of George Spencer Moulton and Co., Limited, and Wood Milne, Limited; Mr. Thomas H. How, chairman of the Engineering Section of the London Chamber of Commerce; Mr. H. L. Symonds, deputy chairman of the Court of the London Chamber of Commerce and ex-chairman of the Manufacturers' Section; and Mr. Lancelot C. Bullock. Their report has just been issued and a copy of it has been forwarded to us.

It appears that there were over 2000 entries for the competition, and they embodied roughly 10,000 suggestions. The judges, however, describe the results as being extremely disappointing. They state that out of the large number of suggestions made it was impossible to find any which, in their opinion, merited a substantial award, and add that, had it been in their power to do so, they would have withheld the principal prizes. There was, they remark, hardly an idea suggested which was not anticipated by Goodyear, the discoverer of vulcanisation, in in his work "Goodyear on Gum Elastic," which was published in 1855. The judges, in fact, speedily came to the conclusion that if absolute novelty was to be the criterion, they would be left with hardly anything to adjudicate upon, and that the suggestions coming under that head would mostly be impracticable, far-fetched or difficult to exploit. They decided, however, that while the suggestions contained in the entries were, on the whole, disappointing, many of them contained the germ of ideas, which in the hands of a technical and practical man might be worked up into a manufacturing possibility, and they accordingly awarded prizes as under, and they have recommended that the entries should be edited by some competent person acquainted with the trade, and that a handbook, giving in a condensed form the particulars of those ideas which are considered to be of merit, should be produced and circulated to all rubber manufacturers throughout the world.

The prize of £1000 was awarded for the suggestion of using sponge rubber for general upholstery purposes, including the making of mattresses, though, as is pointed out, Goodyear actually referred to such use in his book. It appears that no less than eighty competitors made this suggestion, and each of thirty of them receive £9 10s., while the remaining fifty are given £14 5s., because they more fully elaborated their proposals.

One prize of £500 was awarded for the suggestion of incorporating rubber in liquid form with paint or other composition for use in the preservation of wood and metals against the action of the sea, and in the prevention of the fouling of ships' keels. Five competitors share the amount equally between them. Another prize of £500 was awarded for the suggestion of the use of rubber in paint for general decorative and preservative purposes. Nine competitors made this suggestion, and two of them are given £40 each, and the others £60 each, as they had more fully worked out their ideas. A third prize of £500 was awarded for the proposal to use rubber for the valances and mudguards of motor vehicles. Eight competitors shared it, three getting £50 each and five £70 each.

In addition to the foregoing, prizes ranging in value from £100 to £2 18s. 10d. were given for various suggestions, among which were those for incorporating rubber with cement for building purposes; and for the following uses of the material, as a heat-retaining covering for hot-water cisterns; for the construction of sea buoys; in sponge form for the lining of egg boxes; in the construction of ship and wharf tenders; for washstand tops; for the manufacture of soft rubber buttons; under carpets in place of underfelts or felt paper; channelling in place of putty for fixing glass in windows; for moulded blind acorns and cistern chain handles; for the linings and divisions of bottle packing cases; for clothes pegs; for fillets for patternmakers; for caps for the ends of ladders to prevent slipping; for pneumatic bouncers attached to footwear for aiding pedestrians and for purposes of sport; for Arctic and Antarctic equipment requisites and purposes; for linings for the preservation of bleaching vats; in the manufacture of bellows, particularly for foundry purposes; for slip-on jar and bottle covers; in crêpe form for rough surfacing cement; for door handles; for gramophone table tops; for knee caps for colliers; in the composition of certain lubricants; for water deflectors for the handles of brooms, &c.

Institute of Costs and Works Accountants.—The next preliminary, intermediate and final examinations will be held by the Institute of Cost and Works Accountants on December 5th, 6th and 7th, at London, Manchester, Birmingham, Sheffield, Glasgow and Bristol, and other centres will be arranged should sufficient demand arise. Forms of application can be obtained from the secretary, 38, Grosvenor-gardens, S.W. 1.

Chauny Competition.—In connection with the French Devastated Area International Competition, the first prize for sewerage for the Chauny district and the second prize for waterworks have, we learn, been awarded to W. H. Radford and Son, of Nottingham; and the second prize for sewerage and first prize for waterworks to Monsieur Jean Malliard, engineer of the Public Works of Paris. A scientific and technical jury of about forty members, including officials of the French Government, was specially appointed in Paris to judge the schemes submitted. The town of Chauny was badly damaged in the war, but its large commercial works and factories are being rapidly re-built, the district being served by a fine canal, and having other great advantages.

An Automatic Mechanical Train Controller.

We were present recently at the trials of a device for automatically giving a warning in the cab of a locomotive of the position of the signals on the line and for simultaneously applying the brakes, which is conspicuous through its simplicity and dependence on well-tried mechanical elements. The whole of the gear is, in fact, of such a nature that it could be maintained by the ordinary permanent way and signal staff of a railway without special instruction.

The apparatus, which is the invention of Mr. J. J. Daniels, comprises an "interceptor," arranged between the railway metals and connected with the ordinary semaphore signals, together with a set of gear on the locomotive, which operates a whistle, puts on the brakes and, if desired, also closes the engine regulator, or throttle.

The interceptor, as will be seen from Fig. 2, takes the form of a curved metal plate, hinged near one end and supported at the other end by a balance weight in such a manner that the highest point of the curve is 4¾in. above the rail level. In this position the interceptor is at danger, that is to say, it will operate the gear on the engine, which is described later, and in this respect follows the rule of the ordinary signalling system that insists that there should be a tendency to indicate danger unless clear is deliberately given by the signalman. In order to avoid putting more work on the signal levers by using them to depress the interceptor to the clear position, the weight of the locomotive itself is used for the purpose. Close to the interceptor, and alongside one of the rails, there is an ordinary wheel bar, which will be depressed by the flange on the leading wheel of the locomotive before it gets to the interceptor. The wheel bar is connected with a short shaft, arranged in brackets alongside the track, by means of crank arms and a link. The shaft carries a simple dog clutch that operates another crank arm connected with the interceptor by a system of link work. The clutch is connected with the signal wires. The arrangement is such that if the clutch is engaged, which means that the ordinary signal has been moved to clear, the movement of the wheel bar, under the influence of the locomotive wheel, is transmitted to the interceptor, which is drawn down to the clear position. If the clutch is not engaged the interceptor remains at danger regardless of the movement of the wheel bar as the locomotive passes.

In the case of signals that are close to the box from which they are controlled, and thus do not put much work on the levers, the wheel bar is not necessary, and a direct connection is made between the signal wire and the crank shaft for operating the interceptor, so that when the signalman pulls down the signal he also pulls down the interceptor.

Interceptors are arranged in connection with both the distant and the home signals. Those at the distant signals are placed 6¼in. off the centre line of the track, while at the home signals they are in the centre. Besides the rising and falling interceptors just described, there are, near every signal, other fixed interceptors, rising 3¾in. above the rail level and fixed off the centre line of the track, which give warning to the driver that he has passed a signal, but do not apply the brakes or shut off steam. In this way the driver is given notice, in the cab, that he has passed a signal at clear.

The gear on the locomotive—see Fig. 3—comprises a rocker shaft, hung in brackets fixed to the frame, on which there are three levers carrying small rubber-tired wheels. The two outside levers are keyed to the shaft, while the centre one is free to swing. The brackets are adjusted to such a height that the wheels will meet the interceptors as the locomotive passes over and rock the shaft to a degree dependent upon the height of the interceptor. The central wheel operates in connection with the interceptors at the home signals, and is used to apply the brakes hard on, while the outside wheels are for the distant signals. The reason for having two outside wheels is, of course, to allow for the engine running either end first.

Considering first the outside wheels, it will be seen from Fig. 3 that when either one of them is deflected the link A pulls down the end of the rocking lever B and pushes up the rod C. This rod is also shown in the lower part of Fig. 4, and alongside of it, it will be seen, there is a small valve which is connected with the train pipe. This valve is normally kept closed by a spring, and the end of its

FIG. 1—FIXED AND MOVABLE INTERCEPTORS AT DISTANT AND HOME SIGNALS

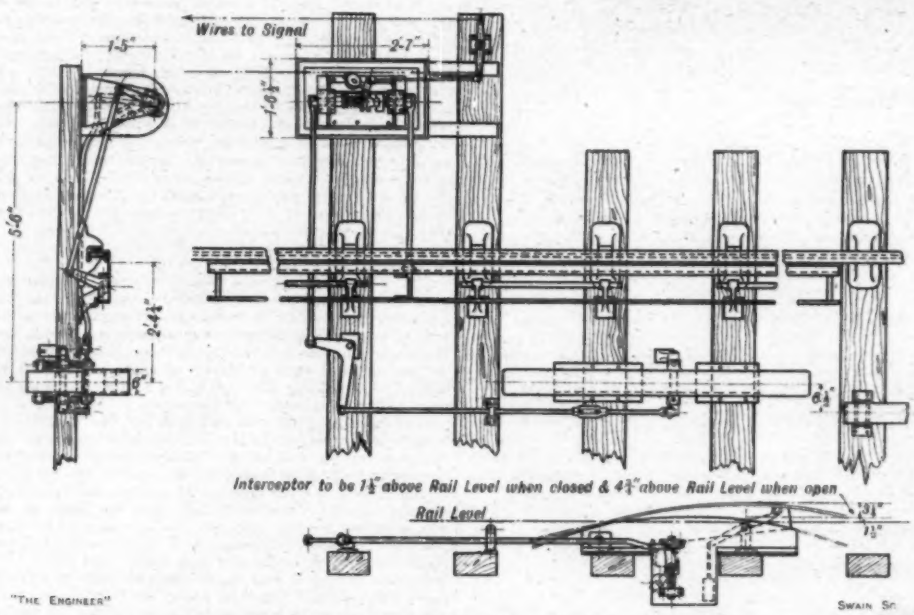


FIG. 2—ARRANGEMENT OF INTERCEPTOR, WHEEL BAR AND CLUTCH

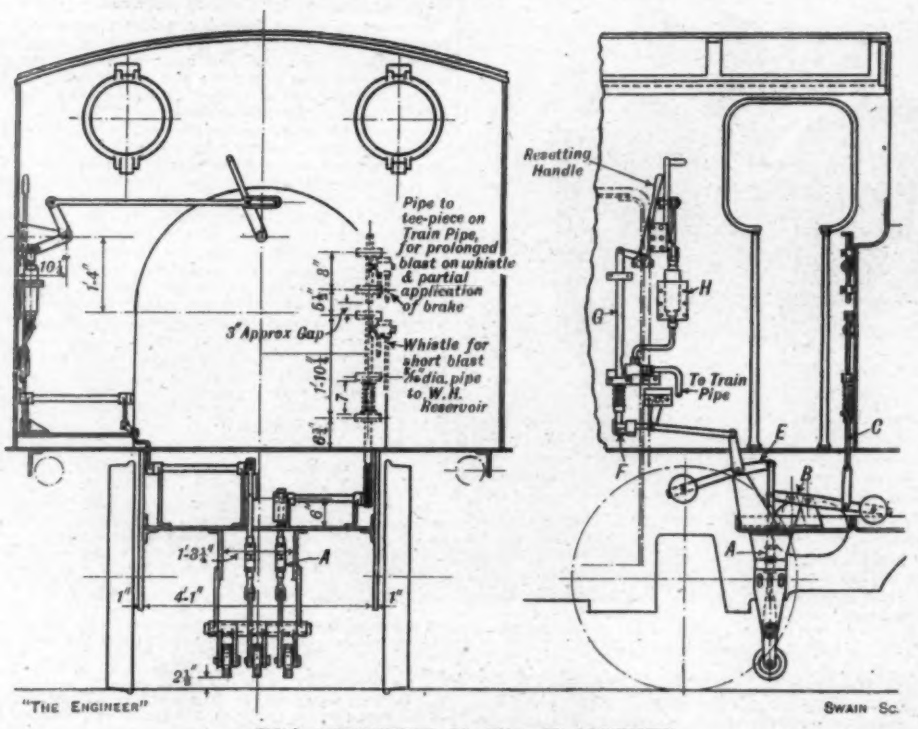


FIG. 3—ARRANGEMENT OF GEAR ON LOCOMOTIVE

FIG. 4—WHISTLES AND BRAKE VALVE

stem rests in a notch in the side of the bar C, but when the bar is raised, on passing a signal, the sloping end of the notch opens the valve, and air is admitted to a little whistle. The bar falls again immediately the engine has passed over the interceptor and the whistle merely gives a short, sharp blast that tells the driver he has passed a signal at clear. Supposing, however, that the interceptor of the distant signal is at danger it is in the high position, and the bar C is pushed further up. It then strikes the bar D and pushes that up also, with the result that a second valve is opened. This valve blows another whistle and releases sufficient air from the train pipe to apply the brakes partially. The bar C drops again, as before, after the interceptor is passed, but the bar D is kept in the raised position by the friction of spring clips in its guides. The result is that the whistle continues to sound until the driver pushes the bar D down again forcibly, and he is thus effectively warned that he has passed the distant signal at danger.

In the event of the driver ignoring the warning he has received at the distant signal and attempting to pass the home signal also at danger, the interceptor there will raise the middle contact wheel on the locomotive and pull down the bell-crank lever E. The trigger F will then be drawn from beneath the bar G, which will fall under the influence of a spring and its own weight. This bar works in conjunction with another valve on the train pipe, which is similar in its action to the valve associated with the rod D, except that the notch in G is cut so deeply that the brakes are fully applied. At the same time air is admitted to a cylinder H, which is connected up with the regulator handle in such a manner that steam is shut off from the engine. A handle is provided for re-setting the gear after it has operated.

The trials to which we have already referred were carried out on the Great Eastern Railway between White Hart Lane and Bruce Grove stations, and it is noteworthy that the apparatus did not interfere in the least with the ordinary traffic. On that occasion the train comprised a six-coupled tank engine and two coaches. The engine was run with the bunker first, which, as will be seen from Fig. 2, meant that the contact wheels passed the end of the wheel bar before the leading pair of wheels on the engine. In spite of this handicap, however, the interceptors operated satisfactorily on each occasion. Several runs were made over the line, which was controlled by a distant and home signal, each fitted with Mr. Daniels' apparatus. On the last trip both signals were set at danger, but the connection between the stop gear and the regulator handle was removed. The train was, nevertheless, pulled up in less than the length of the station immediately following the home signal, from a speed estimated at about 42 miles per hour. Since our visit some other trials have been made for the Automatic Train Control Committee of the Ministry of Transport, and with a full-sized train.

The photographs which we reproduce were taken just outside Bruce Grove station, and in each of them the rising and falling interceptor is shown in the background.

White Lead in Painting.

Case Against Prohibition.

One of the questions to be discussed at the International Labour Conference, which began at Geneva on October 25th, is "The Prohibition of the Use of White Lead in Painting."

In preparation for the Conference, it was the duty of the International Labour Office to collect the most relevant and up-to-date information, to summarise it and set it out impartially, and to indicate the various alternative methods of dealing with the problem. The duty of a fair presentation of the facts and arguments for and against prohibition was, obviously, the more cogent because not a few of the Governments and of the representatives at Geneva will have had no previous knowledge of this particular subject, and are therefore likely to be guided exclusively by any publication purporting to be official.

Instead of adopting this course, however, the International Labour Office issued to the States that will take part in the Conference a memorandum and *questionnaire* which, it is alleged, is undisguisedly a plea for prohibition. Of this document, Lord Askwith has affirmed that it bears "all the marks of haste and ignorance," and "might be well used as an advertising propaganda of a rival pigment."

Perhaps the most striking example of the partisan character of the document, it is urged, is the assumption in the first item of the *questionnaire* :—"In view of the fact that it is now technically possible to replace white lead in painting by efficient substitutes." It is right that the facts bearing on this phase of the question should be before the various Governments when considering their attitude, but it is indefensible that they should be invited to consider the matter upon this question-begging statement of a most controversial matter.

The London Chamber of Commerce issued, some weeks ago, a statement of the "Case Against Prohibition," the broad outline only of which is appended. Valuable statistical and other appendices have been omitted from lack of space.

I.—The Statistics of Lead Poisoning do not Warrant Prohibition.

It is known that owing to the difficulty of diagnosis of lead poisoning, without special experience, very many cases are wrongly attributed to lead poisoning; thus tests made by the objective basophilic granulation method confirmed only 38 per cent. of the cases ascribed to lead poisoning by subjective clinical diagnosis. The tendency to attribute to lead poisoning all possible symptoms in a worker who is known or believed to have had anything to do with lead is influenced by the operation of the Workmen's Compensation Act :—"If the individual has been a lead worker, it is easy but frequently erroneous to conclude the symptoms owe their origin to the worker's occupation." (Legge and Goadby : "Lead Poisoning and Lead Absorption," p. 177). Even so, the English Departmental Committee which considered the question in 1911 stated that "The rates of death and attacks due to lead poisoning among house painters are thus comparatively small." The general health of painters in England is known to compare favourably with that of other occupations. Thus a comparison of the painters' group (1851 persons) with a general group (32,033 persons), both of the Hearts of Oak Benefit Society, for one year shows the following results :—

	General group.	Painters' group.
Percentage claiming benefit	18	11.1
Number of days sickness per member at risk	5.8	4.1

Only one case of sickness was ascribed to plumbism, and three cases to colic in the painters' group.

As to death rates, those for the painters were, at the time of the last census for which figures are available—1901—lower at every age period than those of the group "Occupied Males of Industrial Districts."

The death rates are, indeed, lower than in many occupations not usually considered especially dangerous. Mr. J. H. Schooling, the well-known statistician, has compared the painter's risk with that of the other occupations, as shown in the Registrar-General's report for 1908 (Cd. 2619), and has stated that the figures show that the mortality among painters "is in no way excessive or abnormal; it has been decreasing as rapidly or more rapidly than the mortality of England and Wales, and there is a very large number of most varied occupations, many of which are believed to be ordinarily healthy, in which the mortality exceeds that of painters." While the matter is one which requires the most careful consideration, there is therefore reason to believe that the risk of paint poisoning among painters in England is not more than an ordinary industrial risk.

II.—There is no Effective All-round Substitute for White Lead in Painting

Conditions of space make it impossible to set out the technical reasons for the superiority of white lead paints. Essentially, they are its greater durability and hiding power and consequent economy, especially for outside use. The best practical proof of its superiority is the fact that, at any rate within the British Empire, the master painter prefers to use white lead. It is to his interest to turn out good work, and if substitutes had the advantages claimed for them in the pages of the memorandum of the International Labour Office they would have long ago superseded white lead upon their merits. Buildings which, during the war, were painted with substitutes, owing to the shortage of white lead, are now in a deplorable condition because the substitutes have failed to protect, and have, indeed, left the surface in such a condition that it is difficult to put on a new protective covering.

III.—The Prohibition of White Lead would not Remove all the Chief Causes of Painter's Sickness.

If the risks incident to the painter's occupation are to be dealt with effectively, they must be viewed as a whole, and all the dangers of the use of paint must be studied as to extent, cause and remedies. (*a*) There is now a great deal of evidence to show that many cases of painter's poisoning are wrongly attributed to lead and are due to the volatile thinners used in paints. The poisonous properties of turpentine, benzol, methyl-alcohol, &c., which are used as volatile thinners with most paints, whether with a base of lead or of zinc or other element, are now well known. To the vapours given off by them immediately upon the application of the paint painters are continually exposed. This is believed to be the reason for the prevalence of kidney diseases, and especially Bright's disease, and for the frequency of gout among painters; workers in white lead factories, who are more directly exposed to the dangers of lead, do not commonly suffer from kidney diseases or from gout. (*b*) As to poison from the pigment, the tendency of modern research is to show that poisoning arises from the use of compounds of heavy metals, such as lead or zinc. Modern opinion regards the source of the danger as being, primarily, the inhalation of dust, and secondarily, paint carried to the mouth by paint-soiled hands, &c., and so absorbed by the digestive canal. The primary importance of dust has been emphasised by nearly all the recent Governmental inquiries, Austrian, Belgian, Swiss, German. Dr. Legge, H.M. Medical Inspector of Factories, in his report for 1918, summarising the experience of the years of the war, states :—"On the practical side little more is to be learned as to how lead poisoning is caused, and it can be taken as axiomatic that all risk lies in inhalation of dust or fumes. These removed or prevented, there would be no lead poisoning." This view is strikingly confirmed by the rapid and continuous decrease of cases of lead poisoning in English white lead factories and in the Potteries, owing to the introduction of regulations to prevent the inhalation of lead dust, *i.e.*, in white lead factories a fall from 399 (1899) to 19 (1919), a decrease of 97½ per cent., and in the Potteries from 200 (1900) to 21 (1919), a decrease of 90 per cent.

So far as the danger of poisoning arising from the pigment, whether from dust or from paint-soiled hands, it can be effectively avoided by simple regulations. One inquiry after another has found that the principal causes of dust are the processes of dry rubbing down and dry scraping of paint, which can be replaced by processes of wet rubbing down. Another source of dust, namely, the drying of paint splashes on overalls, can be avoided by the regular washing of them. The danger arising from carrying paint to the mouth by paint-soiled hands, can be met by instruction of the painters as to the risks of poisoning, and the necessity of proper cleanliness.

IV.—Prohibition would be very Costly, and would be Difficult to Enforce and of Doubtful Effect.

(*a*) *The Cost to the Community of Substitutes.*—The number of structures, machines, and implements which require to be painted, if only for protection, shows how large an item of public and private expenditure comes under the heading of "Painting," and how important a consideration is the comparative cost of the use of pigments. The following are some of the facts which cause the use of zinc oxide and leadless paints to be relatively far more costly than that of white lead, it being always borne in mind that labour represents about four-fifths of the total cost :—(1) Their inferior "hiding" power necessitates more coats and proportionately more labour; (2) more coats means a larger quantity of paint; (3) their lesser durability necessitates more frequent re-painting; (4) re-painting is more difficult on surfaces previously painted with substitutes; (5) nothing works so easily under the brush as white lead.

The only seriously suggested substitutes are zinc products; as they are practically foreign monopolies it is not possible to estimate the prices to which they would rise if white lead were prohibited.

(*b*) *Prohibition would have a Disastrous Effect on Home and Imperial Industries :* (1) *The White Lead Industry.*—Since 85 per cent. of white lead is used for paint, prohibition would extinguish the white lead industry in Great Britain, and its workers would be thrown out of employment. In the event of an international prohibition there would, of course, be no outlet by export; nor would the presence of 4 or 5 per cent. of lead in the plumbous zinc white advocated by the memorandum of the International Labour Office materially affect the position. It would not be possible to adapt white lead factories to the manufacture of zinc oxide and other substitutes. White lead manufacturers are large users of certain necessities, such as earthenware pots, timber, spent tan and acetic acid. Their going out of business would adversely affect employment in these industries.

(2) *Imperial Lead Mines.*—The world's annual production of metallic lead is about 1,100,000 tons, of which 210,000 to 220,000 tons, or 20 per cent., are used for conversion into white lead. The great bulk of white lead is used for painting. As zinc oxide is not equal in durability or hiding power to white lead, some 250,000 tons of spelter (crude zinc), or its equivalent in ore, would be required in substitution for the lead used to make white lead.

Deposits of zinc blende (ZnS) pure and simple exist only in relatively small quantities and in limited areas; and these deposits do not occur in the British Empire. By far the greater part of the blendes used in the making of spelter is produced by working deposits of mixed ores, namely, silver-bearing lead and zinc ores. Such deposits exist in many parts of the world, and especially in Australia and Burma; the Broken Hill mine in New South Wales produces 150,000 tons of pig lead and zinc blendes (representing approximately 100,000 tons of spelter) yearly, lead ores being the primary product and zinc ores a by-product.

Prohibition, by reducing the demand by nearly 20 per cent., would inevitably cause a great fall in the price of lead; and, it is stated, would have the effect of closing down the Broken Hill and other mines.

As the zinc industry never has prospered in the United Kingdom and British Empire, the majority of the spelter works and zinc oxide works in the United Kingdom being at present closed, while Belgium and Germany continue to work their factories and smelters and are supplying the British market, the ruinous consequence of putting the British paint industry at the mercy of foreign producers of zinc is but too apparent.

(*c*) If white lead were prohibited and there were no regulations of painting, the painter would still be exposed to the danger of poisoning :—From turpentine or other volatile thinners; from zinc paints (zinc oxide being poisonous, though to a less degree than white lead); from lead in the use of plumbous zinc oxide, the danger in this case being the worse owing to the worker's false sense of security.

(*d*) If, as proposed, there be permitted the use of plumbous zinc oxide (*i.e.*, zinc oxide made by the "direct" process and therefore containing a small percentage of lead impurity), some system of inspection will be necessary for the enforcement of the prohibition of white lead. As it is easy to cover up undercoats of white lead by a finishing coat of zinc oxide, it would be difficult to prevent the surreptitious use of white lead; this surreptitious use would be more dangerous to the health of the painter than the known and regulated use. This point was dealt with in the report of the Geneva Commission as follows :—"It is said that regulations would necessitate a policeman for every job or for every worker. Would it not be necessary to have far more policemen and inspectors, chemists and experts, to ascertain what there is in the paint pots containing countless mixtures of innumerable products of zinc mixed with lead? Is every coloured pigment containing any proportion of lead to be prohibited? If so, the law would be made of no effect, a will inevitably be the case in France." ("La Ceruse," p. 74.)

V.—Regulations Alone would Effectively Deal with the Cause of Paint Poisoning among Painters.

(A) *Nature of Regulations for Painting.*—(*a*) Regulations to avoid dust. Regulations must primarily be directed to the danger of dust, and in particular to dry rubbing down and dry scraping. These should be prohibited.

(*b*) Regulations to ensure cleanliness. Next to dust, the chief source of danger of metallic poisoning arises from paint on unwashed hands and faces, which may be conveyed into the mouth, especially in the handling of food or tobacco. This danger can be met by provision of the means of cleanliness and enforcement of their use. These means may be summarised as follows :—(1) Provision of washing appliances—water, towels, soap; (2) use of overalls and the washing of them; (3) ventilation.

(*c*) General regulations :—(1) Periodical medical inspection is of special importance because paint poisoning is slow and cumulative in its effects. (2) Printed advice explaining the dangers of the industry, with suggestions as to their avoidance, is of importance because the average painter is frequently found to be indifferent to the dangers incidental to his calling.

(B) *The Machinery of Regulations.*—It is not necessary to elaborate any specific scheme. The machinery of enforcement is an ordinary administrative matter for each country concerned, and does not present exceptional difficulties. It is said that regulations would be difficult to enforce because the painting industry is one in which men are engaged on many separate jobs for short periods

and often in quite small numbers. It is admitted that it is not so easy to enforce regulations in such cases as in a factory industry, but effective enforcement is nevertheless quite practicable. It would be quite unnecessary that every job should be inspected; surprise visits and the rigid infliction of penalties would soon have the desired effect. Regulations for the purity of milk are more difficult to enforce than regulations for painting, although of more vital importance, yet a fairly high standard is maintained without daily visits. The observance of a law does not depend on any certainty that a breach will be detected, but upon the knowledge that if discovered it will be punished. It is suggested that the operative painters' trades unions might usefully co-operate in seeing that regulations were enforced, *e.g.*, by officially giving information of breaches.

Governmental Investigations in European Countries.

The subject of lead poisoning has been recently investigated by Commissions of Inquiry in a number of European countries—Austria, Belgium, France, Geneva (State), Germany, Great Britain, Switzerland. With the exception of France and Great Britain (for reasons which the "Case Against Prohibition" shows to be inadequate), all adopted the policy of regulations, and in particular regulations in respect of lead dust.

Of these investigations that of Geneva was perhaps the most illuminating, and its general conclusions may be usefully quoted:—

"(1) White lead as used for painting in Geneva does not constitute a social danger necessitating a measure so extreme as prohibition.

"(2) White lead is a necessity for which zinc oxide is not an all-round substitute.

"(3) Painting with white lead is not a real danger when simple precautions are taken.

"(4) Lead dust may be avoided by the use of white lead in the form of paste, *i.e.*, ground in oil (long been a practice in Great Britain), and by preventing dry rubbing down and dry pumice stoning and burning off of old paint." ("La Ceruse," pp. 17–19.)

It has well been said:—"There is a danger that an ill-considered interference with industry for reasons of hygiene will defeat its own object, and that those very workers whom it is sought to protect, or perhaps an equally important or numerous body of workers will be deprived of their livelihood. Prohibition of the use of a dangerous article is a mode of dealing with the danger which is, in my view, somewhat childish in its simplicity, and would lead to an almost intolerable interference with the machinery of civilisation if it were applied to all the substances which are of greater danger than white lead."

A former inquiry at Geneva reported that:—"The danger is not sufficient to necessitate the prohibition of a material the careful use of which does not constitute a social peril. There is an industrial risk, and we do not suppose that it can ever be abolished in painting any more than in any other occupation. At the forge, the slate quarry, the loom, as a file worker or a dyer, the worker is exposed to risks often more serious. We do not desire by yielding to the quite natural sentiments of those who are concerned for the workers and demand prohibition, unnecessarily to do the business of certain financial and commercial monopolies and of certain manufacturers of zinc, *who are and who will be the masters of the price of it.*" ("La Ceruse," pp. 64 and 69.)

LAUNCHES AND TRIAL TRIPS.

Streefkerk; built by Rotterdamsche Droogdok Maatschappij, to the order of Schaopoeart Maatschappij "de Maas"; dimensions, 421ft. by 55ft. 3in. by 31ft. 6in.; to carry 9350 tons. Engines, triple-expansion, 26½in., 43in. and 73in. by 48in. stroke, pressure 180 lb.; Howden's forced draught fitted; constructed by the builders; trial trip, Saturday, October 1st.

P.L.M. 2, large cantilever framed steamer; built by Sir Raylton Dixon and Co., Limited, to the order of La Compagnie des Chemins de fer de Paris a Lyon et a la Mediterranee; dimensions, 400ft. by 50ft. by 31ft.; to carry 8900 tons deadweight. Engines, quadruple-expansion engines, 23in., 32½in., 47in. and 68in. by 48in. stroke, pressure 220 lb.; constructed by North-East Coast Marine Engineering Company, Limited; trial trip, Monday, October 3rd.

British Mariner, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of British Tanker Company, Limited; dimensions, 440ft. by 57ft. by 33ft. 11in.; to carry 10,200 tons deadweight. Engines, single-screw double reduction geared turbines, pressure 200 lb.; constructed by the builders; launch, Tuesday, October 4th.

Monique; built by the Chantiers et Ateliers de la Gironde, to the order of the Compagnie Auxiliare de Navigation of Paris; dimensions, 425ft. by 57ft. by 33ft.; to carry 10,250 tons, on mean draught of 26ft. Engines, triple-expansion, 27in., 46in. and 76in. by 52in. stroke, pressure 180 lb.; constructed by Société Provencale de Construction Navales; fitted for coal or oil fuel; launch, Thursday, October 6th.

Sheap Garth, single-deck screw collier; built by Blyth Shipbuilding and Dry Docks Company, Limited, to the order of W. A. Souter and Co., Limited; dimensions, 271ft. by 38ft. 6in. by 18ft. 7in.; to carry 2550 tons. Engines, triple-expansion, 22½in., 37in. and 62in. by 39in. stroke; constructed by MacColl and Pollock, Limited; trial trip, Friday, October 7th.

Auvergne; built by J. Samuel White and Co., Limited, to the order of Delmas Freres and Vieljent, of La Rochelle; dimensions, 280ft. by 40ft. by 21ft. 6in.; to carry 3220 tons deadweight. Engines, triple-expansion, 19in., 32in. and 52in. by 36in. stroke, pressure 180 lb.; constructed by the builders; delivered, Saturday, October 8th.

All America, twin-screw cable-repairing steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the All America Cables, Incorporated; dimensions, 295ft. by 37ft. by 24ft. 9in.; to carry 1750 tons deadweight. Engines, twin-screw triple-expansion, 15½in., 25in. and 43in. by 30in. stroke, pressure 180 lb.; constructed by the builders; trial trip, Tuesday, October 11th.

Lobos, motor ship; built by Harland and Wolff, Limited, to the order of Pacific Steam Navigation Company; dimensions, 419ft. by 54ft. by 35ft. 3in.; 6479 gross tonnage. Engines, two six-cylinder four-cycle Diesel oil engines; constructed by the builders; trial trip, Tuesday, October 11th.

Blydendyk, cargo vessel of 6800 gross tons; built in Holland to the order of Holland-America Line. Engines constructed by Harland and Wolff, Limited; trial trip, Thursday, October 13th.

Dunmore Head; built by Irvines Shipbuilding and Dry Docks Company, Limited, to the order of Ulster Steamship Company, Limited; dimensions, 321ft. 3in. by 45ft. by 23ft.; to carry 4000 tons deadweight. Engines, triple-expansion, 24in., 39in. and 60in. by 45in. stroke, pressure 180 lb.; constructed by Richardsons, Westgarth and Co., Limited; launch, Tuesday, October 18th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mather and Platt, Limited, have moved their London office from Queen Anne's-chambers, London, S.W., to 14, Great Smith-street, London, S.W. 1.

Jones and Shipman, Limited, of Leicester, have recently opened a new extension in East Park-road, built to accommodate a comprehensive stock of machine tools.

Medway's Safety Lift Company, Limited, of 1 and 2, Bucklersbury, London, E.C. 4, has just opened a new branch office at 131, Oxford-road, All Saints, Manchester. Telephone number, Central 1764.

We are informed that Mr. Albert W. Claremont, who has been associated with Rolls-Royce, Limited, from its commencement, has accepted the seat on the board of directors of that company which was recently vacated, owing to ill health, by Mr. Ernest Claremont.

We are informed that Mr. Oscar Berry, F.C.A., has been elected deputy chairman of the Commercial Education Committee of the London Chamber of Commerce, and to serve on the governing body of the City of London College as a representative of the London Chamber of Commerce.

We are asked to state that Captain F. S. Barnwell, the designer to the Bristol Aeroplane Company, Limited, has accepted a technical appointment under the Government of Australia, and that his successor, Mr. W. T. Reid, has been appointed to the position of chief designer to the company.

We are asked by Rolls-Royce, Limited, to state that Mr. H. Royce, who for over twenty years was associated with Wolseley Motors, Limited (Vickers Limited), during the greater portion of which period he has been in charge of that firm's purchases department, has joined Rolls-Royce, Limited, as buyer at its Derby works.

The British Tabulating Machine Company, Limited, of 2, Norfolk-street, Strand, London, W.C. 2, asks us to state that as from Monday, October 31st, its purchasing department will be situated at its new factory at New Icknield Way, Letchworth, Herts, to which it requests that all correspondence, advices and invoices relating to supplies shall be sent.

Simplex Conduits, Limited, of Garrison-lane, Birmingham, asks us to state that the address of its branch at Newcastle-on-Tyne has been changed from 61–65, High Bridge, to 72, St. Mary's-place. It is under the same management of Mr. A. G. Robson, and the telephone number and telegraphic address remain as before, *i.e.*, 2615 Central, and "Simplex, Newcastle-on-Tyne," respectively.

Mr. Eric Potter, patent agent and consulting engineer, 27, Chancery-lane, London, advises us that he has recently found it imperative to make a division in his business, with the result that the consulting and supervising engineering work will henceforth be conducted under the style of E. Potter and Co. The activities of the company will, as heretofore, be concentrated upon factory architecture, installation of plant, maintenance, &c.

Contracts.—The Brightside Foundry and Engineering Company, Limited, of Sheffield; has secured the contract for the supply and erection of the complete installation of the superheated and saturated steam pipe work, valves, &c., for the Cossipore electric generating station, Calcutta. The company has also in hand similar contracts for the Ogmore Vale power station, and for the Corporation electricity stations of Dublin, Birmingham, Kettering and Doncaster.—Johnson and Phillips, Limited, of Charlton, London, S.E. 7, inform us that they have just been entrusted by the Post Office Engineering Department with the manufacture, supply, and laying of a trunk telephone cable between Glasgow and Edinburgh. This contract comprises 46 miles of 204-pair cable.

The Rubber Situation.—The Secretary of State for the Colonies has appointed a committee to investigate and report upon the present rubber situation in British Colonies and Protectorates, for the information of the Secretary of State for the Colonies, and to advise what remedial measures should be taken to improve the existing situation. The committee is constituted as follows:—Sir James Stevenson, Bart., Commercial Adviser to the Colonial Secretary, chairman; Mr. G. E. A. Grindle, of the Colonial Office; Sir Stanley Bois, chairman of the Rubber Growers' Association; Sir Edward Brockman, K.C.M.G., of the Malay States Agency; Mr. E. J. Byrne, of the Dunlop Rubber Company; the Hon. Wm. Duncan, of the Straits Rubber Company; Mr. Eric Miller, of Messrs. Harrisons, Crosfield and Co. and Sir Edward Rosling, of the Anglo-Ceylon and General Estates Company. Mr. S. H. Leake, of the Colonial Office, will act as secretary to the committee.

An Oil Gas Burner.—A demonstration was given on November 4th at the Hotel Victoria, of the capabilities of the oil gas burner, devised by Mr. Cleary, which is being put upon the market by the British Petroleum Company, Limited, of 22, Fenchurch-street, E.C. The burner is of the type in which the oil is gasified in a chamber filled with nickel gauze that is heated by conduction from the flame. The oil gas then passes through a regulating needle valve, and issues as a jet which entrains the air necessary for combustion. The mixture then passes into a chamber, where it is still further heated, and issues from orifices arranged according to the service required. It is claimed that no carbon will form in the burner and that it does not require cleaning. At the demonstration it was shown that the burner could be easily adapted for heating or for lighting in conjunction with an incandescent mantle, and it was stated that 10 gallons of water could be boiled with less than one pennyworth of oil.

Exhibition of Hygiene, Strasburg, 1923.—In order to commemorate the centenary of the birth of the great French chemist Louis Pasteur, it is proposed to organise under the auspices of the "Institut Pasteur," of Paris, of the University of Strasburg, and of the city of Strasburg, an Inter-allied Exhibition of Hygiene at the latter city, in which he was a professor of chemistry from 1849 to 1854. A special feature of the exhibition, which will remain open from May to October, 1923, will be that part of it devoted to town hygiene, which will be presided over by Monsieur Keppi, the Vice-Mayor of Strasburg, and which is intended to illustrate the latest achievements in the art of building hygienic towns, having special regard to town-planning and streets, labourers' gardens, drainage, street cleansing, refuse disposal, house construction, the arrangement of flats, the provision of ventilation, heating, light and water, &c. Further information may be obtained by application to Monsieur le Secrétaire, Exposition Interalliée d'Hygiène (2e Section, Hygiène Urbaine), 1, Quai Lezai-Marnésia, Strasburg.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The "Cut" in Pig Iron.

For some time past we have been familiarised with the expressive phrase "cut in prices" respecting the steel trade. But it was something fresh last week to hear the market talk of a "cut in pig iron." There can be no question, however, that the example which furnace owners on the North-East Coast have set in this matter is the action of responsible statesmen. The shortest way to get the idle furnaces of the kingdom into work again is to bring raw iron prices down to something like the level which buyers are expecting, or at any rate to drop prices to a point which will encourage buyers again to enter the market. The 10s. fall in Cleveland is therefore applauded by far-seeing members of the iron trade on Birmingham Exchange, and, of course, the Midland pig iron makers—particularly those of Derbyshire and Northamptonshire—have had to follow the Northern example. The railway rates reduction on ore and limestone, though not by any means all that had been anticipated, or indeed could have been wished, has materially assisted in enabling the cut in prices to be brought off. In fact, the recent cheapening of transport has been one of the main causes, the other contributing factor being, of course, the anxiety of makers to see the furnaces relighted and stocks, where they exist, diminished. On 'Change in Birmingham to-day—Thursday—Derbyshire forge iron could be bought at 5s. less than before the Cleveland drop, and foundry iron at 10s. less, while Northampton forge was procurable at 2s. 6d. to 5s. below previous prices, and Northampton foundry at 7s. 6d. less. The new prices, therefore, became Northamptonshire forge, 97s. 6d.; foundry, 105s.; Derbyshire forge, 105s.; No. 3 foundry, 110s. and upwards at furnaces. Foundries that are getting near the end of their stocks are showing more interest in market developments, but they are making such a poor turnover for the most part that they shrink from committing themselves as regards raw material. It is sufficiently realised that the bottom has not yet been reached in prices, and wherever possible makers are still holding off the market with the intention of taking advantage of supplies when things get to the lowest. In some quarters a further cut by and by of as much even as 10s. again would not, it is declared, be surprising. The declared price reduction is rather an indication of the state of the market than a matter of immediate consequence to this district from the competitive point of view. The carriage from Cleveland is much higher than from such counties as Northamptonshire and Derbyshire, the usual source of pig iron supplies for South Staffordshire. A good deal of pig iron has been put into stock by Midland furnaces, and owing to the special disadvantage in this district arising from high railway rates for the conveyance of raw materials, no further progress has been made in the restarting of furnaces. Furnace owners are moving very warily, the more so as demand keeps at a low ebb. In Northamptonshire there is more activity in the way of restarting, and an additional furnace belonging to the Islip Iron Company, Limited, a well-known source of local supply, is now in operation. South Staffordshire pig iron, whether part-mine, forge or foundry qualities, is still off the market, there being practically no production, as the furnaces remain idle with the exception of the Spring Vale works of Messrs. Alfred Hickman, and this concern uses up all its own pig iron in its steel works. There is general agreement among all the districts that without further relief in raw materials and transport, the new pig iron position cannot be stabilised. So far from coke being cheaper, there has been a withdrawal this week of some of the special concessions previously granted by the suppliers, the explanation being apparently that large quantities of coke are being rushed through to Scandinavia before winter seals up the ports. Foreign competition in pig iron is still very keen. A quotation has been received this week for the supply of French foundry iron sold to analysis at £4 10s. 6d. f.o.b. Antwerp. This would cost in Birmingham about £6, very close to the Midland figure, but in view of the high quality, it is believed that the foreign material will compete successfully. Belgian pig iron, forge quality, has been on offer at £5 5s. 6d. delivered.

Ironmasters' Dilemma.

In the iron trade it is possible to buy finished iron at £13 15s. or less, although the standard price is £14 10s. The mills of the district are, on the whole, rather less active than they were a week ago, the buying spurt having apparently exhausted itself. Orders are strictly for small lots to meet urgent needs. The trade has benefited a little by slightly cheaper coal. There are great complaints about the difficulties attending business just now. Manufacturers are, in fact, on the horns of a dilemma. While, on the one hand, they can neither produce at a profit nor sell their output, on the other hand, they are not prepared to stand aside and allow competitors to take their business. The same circumstances largely account for the very low prices at which orders are being accepted. There are numerous complaints of financial stringency, the settlement of accounts being slower than for a long time past. While the marked bar mills continue to have a fair amount of work on hand, makers of second-class bars are much less favourably placed, the trades for which they minister being still in the throes of depression. General engineering is extremely quiet, and the nut and bolt industry is practically stagnant. It is safe to say that the Black Country works do not average more than a couple of days a week. Even Belgian bars, which can be bought at £10 and under, are not wanted, there being more than sufficient stock to meet such orders as come along. Iron strip at £15 finds a slow market. Galvanised sheets continue the brightest department, with a very fair volume of orders, enabling some of the larger mills to make full time.

Steel.

The market is still waiting for an indication that

the recent cuts in steel prices are overcoming the *impasse*. Prices all indicate very keen competition in the finished and semi-finished departments. It is stated that steel masters are disposing of most of their material without much difficulty in the home trade, though production, on account of costs, continues greatly restricted. Competition is keen in rolled steel. The position, however, has been regularised a little since last week, when certain local steel works declined to follow the drastic cut in prices made in the North of England, at least three concerns withholding quotations on this ground. They have, however, now decided to fall into line, and a certain amount of business is thereby retained in this district which otherwise would have gone to the North of England. One cutting quotation is for angles at £10 10s., the local quotation being £11 for this class of material. The local quotation for steel billets is £8 to £8 10s., but a good deal of this business is going to South Wales, where £8 is said to be accepted, while even lower prices are reported in some cases. The £7 10s. quotation for billets, at which figure some substantial orders were booked, has now been withdrawn. A small amount of business in continental billets is passing at £7 15s., but in the main business is confined to home-made products.

Wire Prices Fall.

Wire values have fallen, on account, it is said, of competition from unassociated firms, chiefly in Yorkshire. Strand wire has been reduced by £2 per ton, and baling wire by £1. With minor exceptions, other descriptions of wire are unaltered. Prices of English wire rods have become firmer. This is another department in which continental competition appears to have spent itself, the cheaper Belgian rods no longer being obtainable.

Co-operative Engineering Again.

Co-operative industrial trading, this time in the engineering trades, has broken out at Coventry, and, as far as I can understand the scheme, in a very amateur form. What is described as a "guild" in the local engineering industry was resolved on at a meeting of the local branches of the A.E.U., and a committee for advancing its object was appointed. A "guild" is described as "the legal body of a trade union that can undertake manufacture. There will be no profits attaching to it, and it will be based upon trade unionism." Further, "the functions of the committee are to ascertain information concerning contracts, plant, finance and all other matters, and as soon as a contract is obtained, it is proposed to rent or purchase buildings and plant for the execution of the work." At present the movement is being worked solely in conjunction with the A.E.U., but the sponsors for the scheme are publishing abroad that "if the hopes of its promoters are fulfilled, it will develop into a National Engineering Guild, having for its object the abolition of the present wage system and the establishing by the workers of self-government in the industry."

Midland Miners' Lower Wages.

The reductions in the wages of miners in the Warwickshire and Cannock Chase coalfields for the present month are approximately 1s. 9d. per shift. They differ in accordance with the grade of the worker. In the case of firemen in the Cannock Chase district, the decrease is 2s. 3d., and in the case of stallmen 1s. 11d. Rates of pay in Warwickshire and Cannock Chase, which are governed by the Eastern District Board, for the present month are fixed at 110.55 per cent. above the 1911 basis, as compared with 140.19 per cent. for October—a fall of approximately 12¾ per cent. Although Cannock Chase wages are declining, they are still a long way removed from the level of 1914, which in the case of the minimum wages of stallmen was only about 4s. 6d. a week higher than it was in 1911. The local miners were prepared for a considerable wages reduction for the present month, the rumour having been set going that the cut would be as much as 3s. per shift. This was a false alarm. Last month the daily minimum wage of the stallmen experienced a rise of 4½d., but bad trade during October caused the owners' working costs to be heavy in comparison with the amount of coal produced, with the result that there is a swing of the pendulum in the other direction, and 1s. 11d. per day is now ticked off the minimum basis rate. If trade should improve to any considerable extent, and the pits work a full week instead of about three days a week, as at present, there would be a prospect of the ascertainment of wages for December showing a change for the better. The monthly calculation of wages may be all right for some reasons, but it entails an immense amount of work in the colliery pay departments, and causes a good deal of uncertainty and irritation in the minds of the miners. Complaints as to the present scale of wages are, however, heard in some quarters. Mr. W. Johnson, general secretary of the Warwickshire Miners' Association, recently stated with regard to the new rate of wages that the whole coalfield of Warwickshire was staggering under the burden of the slump in trade. Some districts were feeling the pressure much more severely than others. In a great number of districts the wages received were considerably below the cost of living. People living in better districts had no conception of the suffering and privation existing in others.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THERE is very little noticeable change in the general position of the iron and steel markets, but the slow sagging process continues and prices are gradually growing easier. There is abundance of proof that the consumer, in adopting a hand-to-mouth policy in buying, has been amply justified. There is scarcely any raw material of the engineering industry which cannot be bought on better terms now than were possible a month or two months ago. The impossibility of keeping up prices is beginning to dawn on the minds of all manufacturers, and the main reason why we do not now see a rapid slump is that there are no orders in the market of sufficient importance to tempt the sellers of material to compete fiercely for them. The textile section is still the best part of the engineering industry, and probably the shipbuilding section is the worst; but general engineering is very slack and languid in this district.

Metals.

The non-ferrous metal market is still in a very depressed condition, and at present there are very few signs of a change for the better. The demand all round is very poor, and it is feared that the further demoralisation of the German exchange may lessen the continental consumption of copper. It is true that the German mark is nothing in itself—merely a scrap of paper—but while calculations have to be made in marks these violent fluctuations hinder business. The difference between standard copper and electrolytic is now great enough to cause a movement of the former into America for conversion into the latter, and if this goes on the said difference may tend to diminish; but, of course, this process of conversion does not change the situation, which can only be improved by a larger industrial consumption. Some hope of this occurring in the near future is raised by the possibility of further electrification of our railways, although it is to be feared that railway finance is not in so good a state as to be able to undertake the expenses which are involved in the process. Another feature of the market is the report that the 150,000—or is it 180,000?—tons of Government brass will be refined into copper of standard quality, and also that the Government has yet about 10,000 tons of rough copper to put on the market. All these reports suggest that a good deal has to be done before the copper market can be got into a sound position. The makers of copper and brass tubes have conceded another ¼d. per pound to the consumer, and the new prices as I write are 1s. 2¼d. per pound (£133 per ton) for solid-drawn and brazed copper tubes, 1s. 0¼d. per pound for solid-drawn brass tubes, and 1s. 3d. for brazed brass tubes, condenser tubes 1s. 4¼d. per pound. The prices for strong copper sheets and bottoms are unaltered at £101 and £111 per ton respectively, but copper braziers (i.e., 4ft. by 4ft. sheets) are offered for India at £94 per ton. The prices still afford a certain amount of amusement to the looker-on, although the engineer who has to pay them may not be so much amused. The market for tin remains steady, keeping near to £156 per ton. Some weakness has been visible in view of the fear that the statistical position would be worse; but the consumption in the tin-plate trade is better, and so long as the big holders of tin in the East do not take fright and sell in a panic there is not much apprehension of lower prices. This is practically the only danger in sight at present, and if it be averted the prospects of the market are fairly good. The market for lead has been easier, but the fall is only slight at present. The supplies of Spanish lead coming to Great Britain are smaller, but larger quantities are going to the Continent, so that the effect of small supplies here is counteracted. In spelter there is a moderate trade, and the supplies coming in are moderate. The galvanising trade takes a fair amount, but the consumption by the brass manufacturers is now, of course, very much below the average.

Pig Iron.

There is not much change yet to be seen here in the market for pig iron. The demand for forge iron is scarcely heard of now, and that for foundry iron, although still in existence, is confined to very small lots for prompt use. The consumer of foundry iron is quite convinced that the prices have yet to be much lower, and that the longer he can hold back his orders the better is his chance of buying at easier prices. Cleveland No. 3 remains at 110s. per ton on trucks, but while the present railway rates are maintained it is of no interest to the Manchester consumer. Derbyshire No. 3 can be bought freely here, even in quite small lots, at £6 delivered, and one cannot say what concession would be made to a buyer of a large lot, if such a buyer could be found; but the foundries are mostly short of orders for castings and cannot buy large lots of pig iron. There is some report of lower costs for the making of iron, and the price of coke has been reduced by 2s. 6d. per ton in the Cleveland district; but very much lower prices for coke will have to come, and buyers of iron know this perfectly well.

Finished Steel.

There are a few more orders in the market for sectional steel at the reduced prices, and it is some satisfaction to feel that orders are not now going so freely to the Continent as they were; but the trade in finished steel is still very dull, and the prices paid cannot give much profit to the maker until costs of production are brought down. The range of foreign prices remains much as it was, or about £2 per ton lower than the range of British prices.

Scrap.

The market for scrap of all kinds is very quiet and dull. For wrought scrap there is very little demand, and the call for steel scrap is not much better. Some foundry scrap is being sold in the district, but the prices are sagging. Common cast scrap can be bought at £5 per ton, or perhaps at a little less, and good broken machinery scrap at £5 10s. For "textile" cast scrap up to £6 per ton is wanted.

BARROW-IN-FURNESS, Thursday.

Hematites.

Conditions have changed very little in the hematite pig iron trade of this district, and business is slow in coming to hand. There is a margin between buyers' ideas of prices and those the smelters are able to put forward, and until this margin is narrowed down no flow of trade can be looked for. In the meantime orders are being placed just for sufficient metal to cover immediate wants. There are only eight furnaces in blast. Some of the iron is being used locally by steel makers and the remainder is going to outside users.

Iron Ore.

The demand for hematite iron ore is quiet, on account of the small number of furnaces in blast, and business is confined to the district, except in a limited way for the highest-grade ores. Most of the pits are on short time and the output is restricted. Quite a number of mines are still idle. For Spanish ore there is a quiet demand and importations have commenced again. At the same time much of the ore that was stored at the Barrow Docks has been forwarded to the smelting works.

Steel.

There are no new features to report this week in the steel trade. Rails are being rolled, together with smaller section steel; but the demand is easy, and, as is the case with iron, buyers are awaiting a further fall in prices. The demand for steel shipbuilding castings is very dull. The foundries generally are only quietly employed.

Fuel.

For coal there is only a limited demand, and not much coke is being used in the district.

Shipbuilding and Engineering.

Vickers Limited have completed the turbine steamer Moreton Bay and she left Barrow on Friday last for Birkenhead, where she was dry-docked. She is to have her trials on the Clyde and take up the London to Australia service on December 7th.

SHEFFIELD.

(From our own Correspondent.)

Coal Trade Position.

IN whatever direction one turns just now, it is to be confronted by the fact that a reduction in the price of fuel—that is, a further reduction—is the iron and steel industries' chief hope of a trade recovery. Inquiries which are coming forward, both from the home and over-sea markets, make it abundantly evident that an increasing volume of business is available as soon as the right price keynote has been struck. I have, I know, said all this, or something very much like it, before, but the reiteration is justified because it reflects the position more exactly to-day than ever before. For that reason I have been seeking the views of men in inner colliery circles as to the situation from their standpoint, and have succeeded in obtaining some interesting opinions, besides statements of fact. For example, on the ascertainment for September—on which wages are adjusted for this month, the percentage increase for the Eastern Division—which includes Yorkshire, Notts, Derbyshire, Leicester, Warwick and Cannock Chase, on the 1911 base rates is 110.55 per cent.—an apparent reduction of nearly 30 per cent. I say "apparent" because it is pointed out to me by the managing director of a large colliery near Sheffield that the correct way to estimate the position is to begin with the 100 per cent. basis and to add to it the percentage paid in October, namely, 140.19, so that the true reduction is as 240.19 is to 210.55 per cent.; in other words, about 12½ per cent., or, expressed in money wages, one-eighth. On that reduction of wages the decrease in cost per ton of coal produced will be about 2s. for Yorkshire, and buyers, for that reason, are demanding further price reductions. As a matter of fact, however, the reduction in wages had been anticipated, and, perhaps with the exception of best house coal, most qualities have been reduced during the last few weeks. It is expected there will be further substantial wage reductions on the ascertainment for October, and these, of course, would operate in December, when, in some sections of the colliery industry, it is feared that trouble may be experienced with the workers—that is, if the percentage reduction is lower than the increased cost of living as compared with 1914.

Railway Rates Too High.

It will be recalled that a short time ago Mr. Hodges, secretary to the Miners' Federation, suggested that the prices of coal for industrial purposes should not exceed 30s. per ton delivered at works, the Government to make up the difference—meaning, of course, a further subsidy for the industry. But so far as the purchasing of fuel at works in this district is concerned, it is safe to say consumers are buying at an average price considerably below 30s. Therefore Mr. Hodges' suggestion leaves this part of the country cold. In THE ENGINEER's Current Prices some important price changes will be noticed under "Sheffield" in the coal list. These are all what may be termed prevailing prices in the general way of business. At the moment, however, there is such a quantity of fuel offered that buyers are able to purchase spot lots at substantially lower rates than those quoted. There is another interesting point. Considerable comment has been made recently regarding collieries selling coal for export at far lower prices than are being accepted for inland. On the face of it that is not a very satisfactory position, and industrial consumers rather naturally contend that if collieries have any price concessions to make they should give the advantage of them to the manufacturer and thus assist him in his fight to win back overseas trade. Now, all that sounds very well until you hear the other side. As a matter of fact, it is precisely at this point, as far as I have been able to gather, that the question of railway rates comes into the picture and constitutes a matter of the utmost importance to the coalfields of South Yorkshire. To transport a ton of coal from Yorkshire to the Humber by rail is costing 8s., but exporters from the Humber can only accept coal on the price basis of Northumberland, Durham and Scotland, where haulage costs are infinitely less. Indeed, it is questionable if the average cost of the shorter hauls in Northumberland is more than 2s. 6d. a ton. The hardship on Yorkshire is obvious.

Prices Have Fallen 40 per Cent.

Foreigners will only buy now at world prices,

which means that for export purposes large quantities of best South Yorkshire hards have had to be sold at the pits at 18s. a ton, simply to secure some of the export trade. If railway rates were reduced by 3s. a ton an immediate benefit would be realised by the railway companies in greatly increased traffic, by the miners in more work for them, and by the industrial consumer, who would reap a benefit, to say nothing of the impetus given to the export trade of the nation. It has to be remembered that in pre-war days 80 per cent. of the weight of our exports was represented by coal, whereas at the present time the tonnage is less than one-half. The Humber used to handle three times as much coal as it is doing just now, the figure in 1913 for Hull alone being 7,945,000 tons compared with 1,520,000 tons. So put, the case should answer the manufacturers' suggestion that preferential treatment is being meted out to the foreigner as against the home industrial consumer. Apart from that, however, the managing director with whom I discussed the point contended that the big bulk of the coal-getters—piece workers—had actually received an increase in wages, whilst in other directions wages are very little lower, in the Yorkshire coalfields, than they were, whereas selling prices for industrial purposes have slumped. The same quality coal that was fetching 48s. in July and August can now hardly be sold at 25s., and slacks that were sold for inland consumption at 28s. do not now realise half that figure. Then take locomotive coal, respecting which the companies are demanding further price reductions. This fuel was bought in October at 4s. to 5s. per ton less than in September, and large steam coal for industrial use in the Sheffield district has fallen by 7s. a ton. These figures, if they demonstrate anything, mean that with wages almost unchanged coal prices have fallen nearly 40 per cent. If house coal has come down comparatively little, it was only that the advantage might be given to industrial fuel as being one of the best means of restoring the trade of the country. These remarks embody the considered views of colliery experts, and if they clash with manufacturers' opinions they will none the less be worth careful consideration.

The General Situation.

As to the general industrial situation, I wish it were possible to write with greater assurance. The best that one can say is that manufacturers seem more than ever convinced that the worst has been seen. Definite signs of a trade recovery, however, are quite another matter. I am not a pessimist, and never have been. But to read into the present state of things any really tangible improvement would be a difficult task. That, of course is not saying that prospects are not on the mend. They are. If raw material markets continue to fall a little longer, assisted by further reductions in fuel prices, there seems every chance of a revival in business before very long. The only trouble is that buyers are always very chary of a falling market. They move with caution, purchasing only sufficient for immediate needs, and that seems to be what is occurring now. When consumers feel that raw material prices have touched bottom and that markets are becoming stabilised—providing that the fall has been sufficient to be effective against foreign competition—I believe things will begin to move. Even now, with all its gloom, and in spite of the general belief that little improvement may be expected before the turn of the year, there continue to develop here and there quite good spots of trade, and these are helping the general position very usefully. None of the manufacturers are anticipating that even with the turn of the year any sudden boom will arise. The belief is that the change from the prevailing slump to a period of sound trade will be a gradual one, and that for that reason it is more likely to be a prolonged and profitable one.

Some Interesting Contracts.

A good many firms here during the motor car building boom equipped their works specially for the production of motor steels and of parts required in motor construction, and have since had to divert their energies into other channels. Now, however, I am told that to a limited extent the demand for these steels is returning and Sheffield firms showing at the Motor Exhibition at Olympia speak of quite a fair amount of business being about. A good deal of interest was taken, in the early part of the week, in the report of heavy bookings by the Austin motor people, near Birmingham, and it was felt that if the company succeeds in reaching this month orders for 5000 cars, as it was reported to be hoping to do, it is quite possible that much of the steel requirements involved would come Sheffield way. Another matter of interest was the report that a firm in the same neighbourhood had booked a contract with the Bombay Corporation for 105 miles of iron water pipes, in the manufacture of which, of course, one or two well-known works in this part of the country are keenly interested. Arising out of the latter report, however, there is a rather curious coincidence. The contract figure was mentioned at £1,500,000, and somehow it seemed to me I had heard of it before. Looking back over THE ENGINEER file, I came across, in August last, a report that a Calcutta firm, backed by Dorman, Long and Co., of Middlesbrough, had secured, in face of severe American competition, a contract for the Bombay Corporation, for 105 miles of iron water pipes at a cost of £2,500,000. The coincidence is really so striking as to suggest the possibility of a little confusion having arisen in the minds of those responsible for the later rumour—though, of course, one hopes that such is not the case, and that the second pipe line will materialise. The building of battle-cruisers for ourselves is all very well, and extremely useful at a juncture like the present, being infinitely more desirable than the distribution of doles for doing nothing, but we have to pay the money ourselves, thus simply taking it out of one pocket and slipping it into another—like the two men who bought a barrel of beer and sold it to each other in pints at a time—whereas ordinary home and overseas industrial orders for goods of a reproductive kind are what is required for the re-establishment of commercial prosperity.

Stainless Iron.

One of the features here just now—apart from the visit of the Duke of York during the week and his opening of the Corporation's Blackburn Meadows generating station, as well as his inspection of one or two of the works, where his Royal Highness must have been struck with the distressing absence of activity—is the progress being made with the new material known as stainless iron. Its possibilities must be very great, though its cost at present, I believe, is one of the most serious problems connected with it. Reference has been made to the new material in THE ENGINEER on several occasions, and it is now pretty generally understood that one of its chief claims is the ease with which it is worked and the fact that it can be used for articles hitherto manufactured in copper, brass, aluminium, and nickel alloy. In fact, there seem few things in the making of which stainless iron cannot be usefully employed, and Sheffield is enjoying a sense of satisfaction that credit for its introduction belongs to the city which gave the world stainless steel. As a great centre of the silver and electro-plate industry one wonders if Sheffield will one day discover how to produce untarnishable ware in the material. That would be fully as important a matter in one direction as stainless steel has been in another.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THERE is as yet little indication of any change for the better in the Cleveland pig iron trade. The recent price-cutting appears to have had no appreciable effect upon the demand, though it is reported that a few inquiries are circulating. The bulk of the consumers are still adopting a waiting policy in the hope of a further fall in prices. Yet it is difficult to see how any further price concessions can be made until railway rates and fuel costs are substantially reduced. The ironmasters cannot be expected to shoulder all the burden of the sacrifice which is necessary to revive the industry; colliery owners and railway companies must do their share, and as yet they have not done so. As an example of the manner in which the Cleveland ironmaster is handicapped, the railway rates to Scotland may be quoted. Before the war the railway charges for the transport of a ton of pig iron from Cleveland to Grangemouth was 7s. 4d.; at present it is 18s. 2d., an advance of 10s. 6d. That extra half-guinea per ton is a serious burden at the moment. With a return to something like pre-war rates Cleveland would be able to compete with the cheap continental iron and re-capture the Scottish market. Under the present conditions Cleveland is shut out by high transport charges, for with the f.o.b. charges and the cost of delivery in Scotland, sea transport is no cheaper than rail. On all hands the ironmasters feel the burden of high rail charges, for it takes nearly 6 tons of ironstone, limestone, coke, &c., to produce a ton of pig iron, and on almost every ton of raw material the railway companies levy toll. The price of coke is an equally serious matter. There has been a drop of 2s. 6d. per ton this week, and medium blast-furnace qualities are now available at 30s. per ton delivered. But the recent heavy reductions in miners' wages should be rapidly translated into lower values for fuel, and ironmasters are now hopeful that the colliery owners will see the wisdom of sharing even more in the sacrifice necessary to restore industry. As there is every prospect of a further reduction in pig iron prices, nobody is inclined to buy ahead, and orders are all for small amounts, but even with prices at the present level it seems now cheaper to buy Cleveland iron in preference to taking foreign iron, with the added uncertainties of delivery in the latter case.

Hematite Pig Iron.

Makers of hematite pig iron are passing through a difficult time. They have cut prices severely, but the demand does not improve, and iron is still going into stock in the absence of buyers. The nominal price is still 120s. for mixed numbers and 122s. 6d. for No. 1; but it is understood that these prices will be cut to the extent of anything up to 5s. per ton for suitable business

Iron-making Materials.

There is no sign of any revival of interest in the foreign ore trade, and in the absence of business the price is nominal at 27s. per ton for best Rubio ore c.i.f. So far as coke is concerned, consumers are only placing orders to meet their daily needs, and substantial business is not to be looked for until the price is further reduced.

Manufactured Iron and Steel.

In the manufactured iron and steel trade there is undoubtedly a determination to shoulder heavy losses in order to get the industry going again. Once prices reach rock bottom it is believed that large orders will be placed, and it is only by mass production that makers can hope to make ends meet. Thus they are anxious to hasten the process of deflation and establishing a stabilisation of prices, and even though they are losing at present prices a further reduction would create no surprise. Meanwhile there is a good deal more inquiry, and this, it is hoped and believed, will lead to an expansion of business. More plant has been put into operation during the week. It had been recognised that in relation to finished steel manufacture the price of billets was too high, and quotations have been adjusted accouingly, a reduction of 10s. per ton bringing down the figure for hard billets to £9 10s., and for medium qualities £9, whilst soft billets are in the neighbourhood of £8 per ton. All other prices are unchanged.

The Coal Trade.

There is little improvement in the Northern coal trade situation. The inquiry is still very far from encouraging, and as a rule the operators both for home and abroad are experiencing a very lean time. The inquiry from abroad is not by any means up to the average, and even when feelers are put about they seldom result in actual business; quotations in every instance, or nearly so, are either ignored or the intimation is received that the figure asked is too high. There have been some preliminary soundings of the market possibilities as regards business for Chili, India, and the coaling stations; but so far nothing definite in the shape of contracts have emerged. Steam coals are, on the whole, quiet, though some of the prime brands are in favour, and are fairly well stemmed; but as a rule all the collieries are in need of prompt trade. Gas coals are very slow, with an output more than plentiful to cover the trade offered; consequently the poorer brands are weak and susceptible to discounting. The household coal trade is not much improved despite lower prices, but as the winter advances there should be a larger turnover. Bunkers are plentiful and supplies are pressed forward with all the possibilities of bargaining at discounted rates. The coke market is slow all round. Foundry sorts are in poor request, while the gas coke trade has fallen away somewhat, and supplies are offered more cheaply.

Heavy Iron and Steel Imports.

Foreign iron and steel producers continue to reap a rich harvest in this district. A return of imports of iron and steel from Holland, Belgium, France, Norway, and Germany, as submitted at a meeting of the Tees Conservancy Commission this week, shows that the amount of pig iron received in the Tees during the past twelve months totalled 78,615 tons, as compared with 1346 tons in 1912–13 and 1427 tons in 1913–14. In October the imports of pig iron reached 20,832 tons, which is the highest amount in the year, the lowest being in May last, 1306 tons. The imports of plates, bars, angles, rails, joists, sheets, &c., from the countries mentioned amounted to 20,948 tons up to October 31st last, as against 23,718 tons in 1912–13, and 19,482 tons in 1913–14. The October imports were much below the average in this instance, the amount being 757 tons. From the same countries the imports of billets, blooms, slabs, &c., from November last year to October 31st last, inclusive, were 34,782 tons, as against 46,521 tons in 1912–13 and 33,655 tons in 1913–14. In this instance the imports for October almost doubled the average for any of the preceding months.

SCOTLAND.

(From our own Correspondent.)

Trade Optimism.

THOUGH in hardly any connection can it be said that business is on the increase, there is no doubt that more optimism exists as to the future. It is not definitely known what has caused this change of feeling, but in many circles it is confidently thought that the worst is over, and that between now and the end of the year a considerable improvement will be noticeable. At any rate, during the past few weeks prices have dropped at a quicker rate than formerly, and wages in the staple industries have become much lower, while in some instances further reductions are imminent. Consequently, cheaper productions are anticipated. So far as purely local business is concerned, the recently placed Admiralty contracts are bound to bring a certain amount of activity, and thereby relieve the situation somewhat. Cheaper fuel, too, is certain to have a stimulating effect. The export departments present a different problem, however, and until financial conditions abroad are more stable improvement must be delayed. Overseas markets are seriously understocked, and inquiries are freer, but the feeling of insecurity is too strong. Further reports of protracted deliveries from continental factories are more numerous, and home makers expect soon to benefit from this circumstance in their dealings with both home and foreign markets.

Pig Iron.

Progress in pig iron is slow. Though only about eighteen furnaces are in blast, great difficulty is experienced in disposing of outputs, and makers are not inclined to add to stocks at present. While local prices continue in the down grade, they are still too far above the quotations for imported material to induce consumers to anticipate requirements. Meantime, orders are of small bulk, representing a day-to-day system of buying.

Steel and Iron.

The recent reductions in steel products are expected to influence business. Nothing of much importance has happened so far, but inquiries for structural material are active. Sheets, too, are a little busier, and galvanised descriptions are receiving more attention, especially from the Far East. Wrought iron and steel tubes are fairly busy. Bar iron, also, is not just quite so dull as recently, but in this department there is ample room for improvement. In spite of the general dullness, a fair turnover in rivets, spikes, bolts and nuts is reported. The engineering trades are very slack, and makers of all kinds of castings are sorely in need of fresh business.

Coal.

The past week was again one of little activity, and all departments of the coal trade were dull in the extreme. Lower sales showed no feature of note, apart from a slight increase in house coal business. Industrial orders were limited, and the turnover in other directions was of a day-to-day description. Export, though not so large as in the preceding week, still showed some movement other than coastwise. In Lanarkshire, the collieries had a number of export orders for ell coal, which was selling at a fairly firm figure. In the Lothians some good orders were received for screened sorts, but in that district and in Fifeshire a drop in the turnover was noticeable. In all districts smalls are neglected, and can be obtained at fairly cheap rates. The demand for overseas tonnage has quietened a little, but there are signs of a bigger revival and of calls for larger cargoes, as more favourable prices for round coal are anticipated. Aggregate shipments for the past week amounted to 176,015 tons, against 191,263 tons in the preceding week and 322,360 tons in the same week in 1913.

Transport Charges: A Comparison.

A day or two ago there was published a comparison between transport charged in 1919 and 1921. The following extract is the table of charges from two collieries in Lanarkshire to various docks, depôts and works :—

To	No. 1 colliery. 1919–1921. s. d. s. d.	No. 2 colliery. 1919–1921. s. d. s. d.
Glasgow Docks ..	1 10½—4 3	2 2½—4 11
Leith Docks	2 6½—5 8	2 0½—4 7
Edinburgh depôts ..	3 5 —7 4	2 11½—6 5
Grangemouth ..	2 0½—4 7	1 11½—4 5
Electricity works ..	3 5 —7 4	—
Gasworks	1 11½—4 1	—
Locomotive works..	1 9½—4 1	2 7½—5 10

In view of the above figures, it is contended that a reduction in these charges is long overdue.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Steam Coal Prices.

It goes without saying that the question as to what price coals can be obtained at, not only for current shipment, but for delivery over a fairly long period ahead, such as six or twelve months, is an ever present one in coal trade circles at Cardiff; but it is more vital than ever at the moment, because business is so scarce and competition is keener than even in pre-war days. Furthermore, with the knowledge that prices must come down if the foreign export trade is to be recovered, and that collieries are working on a limited scale, exporters have to use no little amount of judgment and accept considerable risks in quoting for business, if they are to secure orders and at the same time come out of it to their advantage. Foreign consumers are very careful about buying, prompt cargoes being all that they are prepared for the most part to go in for; but they expect all the time that present prices should be discounted. Thus, if exporters desire to secure orders they must quote prices which represent practically bare cost, if not a loss, and trust to picking up their coals at the time of shipment at less than they had quoted, or of chartering tonnage at a rate lower than when they put in for the business. The view is, of course, general that prices of coals must come down still further, but to what extent it is difficult to say. Ever since the resumption of work following the strike, collieries have had to exercise the most rigid economy in all directions, and apart from the fall of wages, other costs have slightly relaxed, but it is evident that the scope for further curtailing their expenses is very severely limited, and the main hope of many undertakings securing their coals at a lower figure than is now prevalent is for the output per man employed to be considerably improved upon. This is shown by the recent action of a number of collieries in threatening to close their pits if the production was not increased. Bearing in mind, therefore, that at recent prices numerous collieries have been losing several shillings per ton on all coal sold, it becomes very inopportune for anyone, with an air of authority to give widespread publicity to the theory that coals can be produced at a profit at 20s. per ton without any details as to what coals are meant. Such a statement is likely to do the foreign export trade an infinite amount of harm, as buyers abroad are sufficiently reluctant to operate and will be more than ever determined to hold off.

Expert Opinion.

The question of prices has been taken up by the secretary of the Coalowners' Association, who points out that the wages in this district are practically at the minimum. They are only above that point by 0.95 per cent., which is, in the circumstances, an almost negligible fraction. The position is that the wages cost on total output, at the minimum of 28 per cent. on the 1915 standard rates, amounts to 13s. and other costs 8s., making 21s. per ton at pithead. Adding railway rate and dock charges, after allowing for recent concessions of 5s. 3d., the total cost is 26s. 3d. per ton pithead. When considering these figures it has to be borne in mind that no allowance for profit or any capital charges is made in this amount, and that the figure of 26s. 3d. is exclusive of the cost of other services, such as those of the clerical and administrative staffs, managers, &c., and, further, that it is calculated on the total coal produced, and not on the coal commercially disposed of, and on the average the coal commercially disposed of is 8½ per cent. less than the output. It follows, therefore, that as the coal sold f.o.b. is distributed approximately in the proportion of two-thirds large for one-third small, the price at which large coal must be sold is considerably in excess of the average cost of 26s. 3d. of all the coal produced. The secretary of the coalowners states that since 1914 there have been the following increases in costs :—Wages, 4s. 11½d. per ton; other costs, 5s. 5½d. per ton; and transport, 3s. 3d. per ton; and he adds that if prices are to be reduced it can only be by a reduction in wages costs, in the cost of stores and in transport charges. There are none more eager than the coalowners that prices should be brought down to a level that will enable South Wales to recover its inland and export trade and to restore its pre-war prosperity, but they cannot sell at low prices except on the condition of low costs. Costs can be reduced by greater outputs, lower transport charges and by cheaper pitwood and other raw materials; but under the conditions that exist to-day they cannot be reduced to the figure—20s.—suggested by people whose knowledge of the situation in South Wales is only too clearly incomplete.

Wages in Steel and Tin-plate Trades.

The workmen engaged in the tin-plate trade of South Wales have agreed to accept the offer of the employers referred to last week, this offer being a 10 per cent. additional bonus, which means, with the 7½ per cent. of the sliding scale and the 25 per cent. consolidation, 46.8 per cent. on the old base wage rate. The Joint Industrial Conciliation Board has also offered steel workers an extra 6d. per shift to men over eighteen and 3d. per shift to those under that age, to meet the cost of living. The men's representatives promised to give their reply in a week's time and in the meantime are consulting the workmen.

Price of Steel Bars.

Contrary to expectations, but with a view to encouraging the tin-plate and galvanised sheet industries, the South Wales Siemens Steel Association has further reduced the price of bars from £8 5s. to £7 15s. per ton. The sliding scale agreement governing wages becomes inoperative if bars fall below £7 10s. per ton.

Colliery Deal.

Shareholders of the Gwaun-cae-Gurwen Colliery Company some time ago received an offer from Guest, Keen and Nettlefold for the acquisition of their holdings on the basis of the exchange of one Guest-Keen ordinary share for each Gwaun-cae-Gurwen ordinary share and one Guest-Keen 5 per cent. preference share for each of the 7 per cent. Gwaun-cae-Gurwen preference shares. The offer was made conditional on shareholders representing 90 per cent. of the capital of the Gwaun-cae-Gurwen Company. Replies from the shareholders show, however, that this condition was not complied with, the acceptance representing only 80 per cent. of the capital. Notwithstanding this, it is understood that Gest-Keen have waived this condition and therefore the deal has gone through.

Current Business.

The main feature of the coal market during the past week has been the steady but very gradual relaxation in values. The flow of business is very meagre and wholly insufficient to put any life into the conditions; and furthermore, more collieries have come into working since the beginning of this month, with the result that there is more coal about. Buyers are not purchasing ahead, and when they do get orders they find it is a more paying proposition to keep the business well in hand until their tonnage is practically ready, and then go to the collieries and get them out of difficulties as regards wagon supplies, at the same time getting a concession in price. Of course this process cannot always be adopted; it much depends on the class of coal required. In the case of special grades, such as highly bituminous coals or sized qualities, it is a dangerous practice, as those descriptions are scarce and firm, as also are best steam smalls. With regard to business ahead, tenders are asked for 150 000 tons of coal for the Brazilian Central Railway. These tenders have to be in by the 14th inst. The Norweigan Railways recently called for prices for 20 000 tons of one of the best Admiralty large coals double screened for supply over this month and next, but very grave doubts are entertained whether the business will come to South Wales, as prices sent in for North County and Yorkshire coals are on a much lower basis. There is a difference of 5s. to about 9s. per ton between the prices for these coals and the best Welsh coal, so that the probability is that this disparity will mean that the order will go North. South Wales anthracite coals keep in the main very firm, except as regards peas, rubbly culm, and duff coals, but large coals, nuts, beans, and cobbles are practically unobtainable for shipment this month, as collieries are so fully booked up.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Admiralty Requirements.

The British Admiralty is in the market for supplies of steam coals over the next twelve months. No particular quantity of coals is specified, but although the requirements of the authorities are considerably reduced as compared with recent years, it is fully expected that the total will run to about three-quarters of a million, if not more.

Steel Trade Wages.

The ballot of the workmen in the South Wales Siemens steel industry shows that the men have agreed by a large majority to accept the offer of a grant of 6d. per shift to all over eighteen years of age and 3d. for all under eighteen.

New Lock Gates.

The operation of erecting new lock gates at the East Basin, Cardiff docks, has now been completed. Each of the new gates weighs about 75 tons. The work has been carried out by Armstrongs and Main, Limited, of Glasgow.

Swansea Metal Exchange.

The tone this week was a little brighter, and wages questions affecting tin-plate workers and steel workers being settled, more inclination was manifest on the part of tin-plate manufacturers to book orders. They are quoting 22s. 6d. basis f.o.b. for prompt supplies. More works are now in operation, and it is calculated that production is now 65 to 70 per cent. of the normal.

Interest in the railway grouping scheme has been revived by the official notices summoning the shareholders of the London and North-Western Railway to a public meeting at Euston on the 17th instant, and those of the Lancashire and Yorkshire to one in Manchester on the same day, to consider and, if so determined, to approve a scheme for the amalgamation of the two companies.

CATALOGUES.

Brown, Bayley's Steel Works, Limited, Sheffield. List 21 deals with stainless steel for hydraulic, steam and mining plant.

H. C. Slingsby, 142–146, Old-street, London, E.C.—Illustrated price list of barrows. List No. 151 gives many examples of different types of barrows which are available at the present time.

Sulzer Brothers, 31, Bedford-square, W.C. 1.—Illustrated leaflet which shows examples of "Sulzer" Diesel engines, which have been delivered or are on order for service in all parts of the world.

Edward Le Bas and Co., Dock House, Billiter-street, E.C.3.—New illustrated catalogue of G.F. malleable tube fittings, suitable for gas, steam and water. Over 7500 different types of fittings are shown, a great number of which are now in stock.

George Ellison, Perry Barr, Birmingham.—List of lantern slides illustrating various types of electric control gear which have been prepared by the firm. Engineering and technical societies and technical colleges may hire these slides from the firm.

Smith and Coventry, Limited, Gresley Ironworks, Manchester.—Section J of general catalogue, which deals with S. and C. patent spiral bevel gear planer. Many pictures and good technical descriptions of the working of these planers are given.

The Rees Roturbo Manufacturing Company, Limited, Wolverhampton.—Illustrated pamphlet R 191 deals with single-stage and multi-stage type of pumps manufactured by the company. A full technical description is included, and many diagrams of the pumps are given.

Morton and Weaver, Cox-street, Coventry.—Illustrated catalogue describing plain and universal cutter grinding machines, high-speed power hack sawing machine, and various small tools manufactured by the firm. The firm is making a speciality of a completely equipped universal tool and cutter grinder for tool-room work.

Edison Swan Electric Company, Limited, Ponders End, Middlesex.—Illustrated catalogue dealing with the subject of industrial lighting. Illustrations are given which will serve as a general guide. The weights, quantities and dimensions are approximate. Although prices are given, the company notifies us that they are subject to alteration.

The Vaughan Crane Company, Limited, Openshaw, Manchester.—Exceedingly well produced and profusely illustrated catalogue of hand and power-worked overhead cranes of various types and for numerous purposes; electric trolley hoists; electric blocks; wall jib cranes; pulley blocks; overhead runways and runway trolleys, warehouse hoists, &c.

Bucyrus Company, Iddesleigh House, S.W. 1.—Bulletin H. 101 deals with hydraulic dredgers for river, harbour and canal excavation, and for land reclamation. Illustrations are given showing these machines at work on different contracts. Bulletin R. 1 deals with dipper dredgers suitable for river, harbour and canal excavation. The different types used are illustrated.

Brush Electrical Engineering Company, Limited, Falcon Works, Loughborough.—Illustrated brochure dealing with the "Brush-Ljungström" turbine. Whilst being a revised edition, much additional material is included, mainly in relation to the 5000-kilowatt unit, with its radial blading at the exhaust end. Overall dimensions and shipping particulars for all sizes have been added.

The Stanton Ironworks Company, Limited, near Nottingham.—Illustrated pamphlet describing the Stanton Hume reinforced concrete pipe, specially suitable for water and sewage construction work. Full details are given regarding the centrifugal process, the concrete produced by which is much greater in density than ordinary concrete. The method of joining is also dealt with, and the weights of pipes are given.

Cole, Marchent and Morley, Limited, Prospect Works, Wakefield-road, Bradford, Yorks.—An illustrated pamphlet dealing with Delas air extractors. The firm has recently arranged to manufacture these machines under licence from La Société Condenseur Delas, Paris. The principle of the working of the machine is different from that of machines on the market at present, and full details are given in the pamphlet.

Martin Brothers (Machinery), Limited, 33–35, Bridge-street, Manchester.—A copy of the new power transmission machinery section of Messrs. Martin's main catalogue. For many years Messrs. Martin have been specialising in these goods, and they have always concentrated on delivery. Extensive stocks are held at the present time in mill gearing supplies, shaftings, couplings, hangers, pedestals, and more especially pulleys. Nearly every article chronicled in this catalogue is priced.

Pollock and Macnab (1919), Limited, Bredbury, near Stockport.—General catalogue of machine tools. This catalogue contains details of machines manufactured by the company. All the tools are British made, and the company is open to receive inquiries for machine tools not included in the list. On receipt of the necessary particulars, Messrs. Pollock and Macnab will quote for complete manufacturing equipments for engineering works. Illustrations are given of all the machines produced by the firm.

Marshall, Sons and Co., Limited, Gainsborough.—Publication No. 1214, dealing with Marshall steam tractors. Whilst these steam tractors are primarily intended for haulage work, they may be utilised in many other ways, viz., driving thrashing machines, dynamos, saw benches, stone breakers, mortar mills, pumps and other kinds of machinery by means of a belt. By means of detachable extensions to the width of the wheels, these tractors may also be well employed for direct traction, ploughing and cultivating. A special page has been inserted in this catalogue, which deals with the Marshall fire-box, with patented cambered top.

T. Cooke and Sons, Limited, Buckingham Works, York.—(1) Publication No. 521 deals with the use and adjustments of the direct reading tachometer. This instrument has been developed by Messrs. Cooke in conjunction with Professor Jeffcott, of the Royal College of Science, Dublin. Whilst the first delivery of instruments has been sold out, Messrs. Cooke hope to supply any requirements in the next three months. (2) Illustrated catalogue dealing with surveying and other scientific instruments manufactured by the firm. This general catalogue comes under the reference number 526. Whilst the prices are not given in this particular catalogue, a special price list, No. 533, is now in the press, and may be obtained on application.

Galloways, Limited, Knott Mill Ironworks, Manchester.—(1) Illustrated catalogue describing the different boilers manufactured by this firm. Many coloured diagrams have been inserted in this edition, showing the lay-out of plants put down by Messrs. Galloways. (2) Illustrated catalogue dealing fully with boiler fittings suitable for Galloway boilers, Lancashire boilers, dry-back, waste-heat and Cornish boilers. Sectional diagrams of the different fittings are given. (3) Illustrated leaflet dealing with the boiler fittings that are made with "Magnam" alloy. (4) Leaflet illustrating uniflow steam engines fitted with silent valve gear and automatic compression regulator. These engines are constructed in sizes from 100 to 5000 horse-power, suitable for any working pressure and high superheat.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	37/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland— (2)		
Hematite	7 2 6	—
No. 1 Foundry	6 15 0	—
No. 3 ,,	6 12 6	—
N.E. Coast—		
Hematite Mixed Nos.	6 0 0	6 0 0
No. 1	6 2 6	6 2 6
Cleveland—		
No. 1	5 15 0	6 0 0
Silicious Iron	—	—
No. 3 G.M.B.	5 10 0	5 15 0
No. 4 Foundry	5 5 0	5 0 0
No. 4 Forge	5 0 0	5 0 0
Mottled	4 17 6	4 17 6
White	4 17 6	4 17 6
Midlands.		
Staffs.—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	*None offering.*	
,, Foundry No. 3	*None offering.*	
Northampton— (3)		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	5 5 0	—
,, Forge	4 17 6	—
Derbyshire— (3)		
No. 3 Foundry	5 10 0 to 5 15 0	
Forge	5 0 0 to 5 2 6	
Lincolnshire—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	
N.W. Coast— (4)		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	7 5 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	14 0 0	—
Best ,,	17 0 0	—
N.E. Coast—		
Common Bars	14 0 0	—
Marked ,,	18 0 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	14 0 0	—
Hoops	17 5 0	17 0 0
S. Yorks.—		
Crown Bars	14 10 0	—
Best ,,	17 0 0	—
Hoops	17 5 0	—
Midlands—		
Marked Bars (Staffs.)	17 10 0	—
Crown Bars	14 10 0	—
Nut and Bolt Bars	14 10 0	—
Gas Tube Strip	15 0 0	—
Hoops	17 10 0	—

STEEL.

	Home. (6) £ s. d.	Export. (7) £ s. d.
Scotland— (5)		
Boiler Plates	16 0 0	—
Ship Plates ¾in. and up	12 10 0	—
Sections	12 0 0	—
Steel Sheets ⅛in. to ¾in.	13 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	20 0 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	16 0 0	—
Joists	10 10 0	—
Heavy Rails	10 10 0	—
Fish-plates	15 10 0	—
Channels	14 10 0	—
Hard Billets	9 10 0	—
Soft Billets	7 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	11 0 0	—
Light ,,	13 0 0 to 15 0 0	
Billets	10 0 0	—
Ship Plates	10 10 0	—
Boiler ,,	16 0 0	—
Manchester (*Prices irregular and uncertain unchanged*)—		
(8) Bars (Round)	10 0 0 to 12 0 0	
(8) ,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	17 5 0	17 0 0
,, (Soft Steel)	14 5 0	14 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	
Sheffield—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	10 0 0	—
Soft ,,	8 10 0 to 10 0 0	
Hoops	14 5 0	—
Soft Wire Rods	12 0 0	—
Midlands—		
Small Rolled Bars	11 0 0	—
Bessemer Billets and Sheet Bars	8 0 0 to 8 5 0	
(2) Hoops	13 10 0	—
Tube Strip	11 10 0	—
Sheets (24 W.G.)	15 0 0 to 16 0 0	
Galv. Sheets (f.o.b. L'pool)	18 10 0 to 19 0 0	
Angles	10 0 0	—
Joists	10 10 0	—
Toes	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	21/6 to 23/-
Block Tin (cash)	153 10 0
,, (three months)	160 10 0
Copper (cash)	66 5 0
,, (three months)	66 15 0
Spanish Lead (cash)	23 15 0
,, (three months)	23 7 6
Spelter (cash)	25 15 0
,, (three months)	26 7 6
Manchester—	
(9) Copper, Best Selected Ingots	68 0 0
,, Electrolytic	73 0 0
(10) ,, Strong Sheets	101 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	25 0 0
,, Foreign	24 0 0

(*Metal prices practically unchanged*).

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£28	12/-
,, 6 p.c. to 8 p.c. ,,	£26	10/-
,, 8 p.c. to 10 p.c. ,,	£26	10/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese	(per ton) £18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	21/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	14/6 per lb.	
Aluminium (per ton)	£110 to £120	

(British Official).

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	25/-
,, ,, Ell	26/6
,, ,, Splint	25/6 to 30/-
,, ,, Trebles	26/-
,, ,, Doubles	23/-
,, ,, Singles	18/6
Ayrshire—	
(f.o.b. Ports)—Steam	25/-
,, ,, Splint	25/6
,, ,, Trebles	26/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	20/- to 24/-
Screened Navigation	30/-
Trebles	25/6
Doubles	22/-
Singles	18/6
Lothians—	
(f.o.b. Leith)—Best Steam	23/-
Secondary Steam	22/-
Trebles	26/-
Doubles	23/6
Singles	18/6

ENGLAND.

(11) N.W. Coast—	
Steams	36/6
Household	40/- to 55/-
Coke	37/6 to 40/-
Northumberland—	
Best Steams	23/- to 24/-
Second Steams	21/6 to 22/-
Steam Smalls	16/6
Unscreened	22/6 to 25/-
Household	25/- to 30/-
Durham—	
Best Gas	24/- to 24 6
Second	21/- to 23/-
Household	25/- to 30/-
Foundry Coke	40/- to 42 6
Sheffield— (12)	
S. Yorks. Best Steam Hards	32/- to 33/-
Derbyshire Hards	31/6 to 32/-
Seconds	30/6 to 31/6
Cobbles	30/6 to 31/6
Nuts	28/- to 30/-
Washed Smalls	17/- to 18/-
Best Hard Slacks	17/6 to 18/6
Seconds ,,	17/- to 17/6
Soft Nutty ,,	17/- to 17/6
Pea ,,	11/6 to 12,6
Small ,,	9/- to 10/-
House, Branch	40/- to 41/-
,, Best Silkstone	37/6 to 39/-
Blast Furnace Coke (Inland and Export)	25/- to 30/-

(13) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	26/6 to 27/-
Second ,, ,,	26/- to 26/6
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	25/6 to 26/-
Western Valley ,,	25/- to 25,6
Best Eastern Valley Large	25/- to 25/6
Ordinary ,, ,,	24/- to 25/-
Best Steam Smalls	18/6 to 19/-
Ordinary ,,	12/6 to 18/-
Washed Nuts	32/6 to 35/-
No. 3 Rhondda Large	30/- to 32/6
,, ,, Smalls	18/- to 20/-
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 22/-
,, ,, Smalls	15/- to 16/-
Coke (export)	47/6 to 52/6
Patent Fuel	27/- to 29/-
Pitwood (ex ship)	37/6 to 40/-
Swansea—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	52/6 to 55/-
Red Vein	47/6 to 50/-
Big Vein	55/- to 57/6
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	60/- to 62/6
Peas	24/- to 25/-
Breaker Duff	8/- to 8/6
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large	27/- to 29/-
Seconds	26/- to 27/-
Smalls	12/6 to 16/-
Cargo Through	20/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. (7) Export Prices—F.O.B. Glasgow. (8) Prices represent the real market before the *official* change was made.
(9) These prices are practically alike now. (10) Sheets reduced while other prices are advancing.
(11) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (12) For inland sales. (13) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Harbour Extensions.

In the programme of public works to be carried out during the next fifteen years special prominence is given to the development of the ports, for which more than 1000 million francs have been attributed, notably to Marseilles, St. Nazaire, Nantes and Bordeaux, while the works to be executed at Havre have been so largely added to from time to time by the various laws passed between 1909 and 1919 that the expenditure at that port alone is expected to exceed 500 million francs. As a matter of fact, the estimate of 86 million francs for the first part of the programme will be found to exceed 250 millions. Some information upon the work being carried out at Havre was given by M. Hersent in a communication to the Société des Ingénieurs Civils de France, who explained what had already been done with the new docks and the 1000 m. wharf for Transatlantic vessels, of which about one-half is completed. One of the most interesting works, however, is the construction of a dry dock for accommodating vessels up to 100,000 tons displacement and drawing 13.5 m.—say, 44ft. 3in.—of water. The inside length of the dry dock will be 312 m. and its width 52.50 m. A foundation is being made with a huge caisson 345 m. long and 60 m. wide, the metallic framing of which is made up of six longitudinal girders 6.40 m. high and forty transversal girders. The total weight of the caisson will be about 8000 tons.

Hydro-electric Supply.

The considerable diminution in the energy supplied by the hydro-electric plants in the Isère as the result of the particularly long period of drought has become so serious a matter that nearly all the companies are now proposing to carry out extensive works to ensure a greater regularity of distribution. A large proportion of the energy produced in the Isère is sent to the Loire, where it is employed mainly for industrial purposes, and as the metallurgical and other concerns can no longer rely upon the existing electrical distribution there are projects for putting down powerful generating plants which would serve to regulate the supplies from the hydro-electrical installations. At the same time the companies in the Isère are proposing to construct new dams, one on the Romanche for holding up 80 million cubic metres of water, while another may be built across the Vence Valley. There are also plans for utilising the Laffray and other lakes for generating electrical current

Natural Gas.

During the past two years borings have been carried out in many parts of the country in the hope of tapping supplies of oil, and while oil-bearing strata have been met with occasionally the results have not been encouraging. So far the only workable petroleum deposits have been found at Pechelbronn, in Alsace, but the researches have revealed the presence of natural gas at Vaux, in the department of the Ain. While boring for salt fifteen years ago gas was encountered in small quantities, and two other borings were subsequently made; but it was not until last year that the work was undertaken seriously, and on September 1st last gas was found at a depth of 223 m. The bore has since been delivering about 100,000 cubic metres a day with little variation. This success has revived interest in the search for hydrocarbons, which it was hoped would make up for the deficiency of coal, and the existence of natural gas in large quantities leads to the belief that there may be workable deposits of oil.

Paris Traffic.

Since the transport service in Paris was taken over by the Department of the Seine, which has amalgamated the omnibus and tramway companies into one concern known as the Transports en Commun de la Région Parisienne, a notable improvement has been effected in the service, and several projects are now under consideration for facilitating transport between Paris and the suburbs. The growth of traffic has so far congested the city that it has been proposed to restrict or suppress the tramways, which are the principal cause of the trouble; but as this is obviously out of the question for the time being the Prefect of the Seine has decided not to authorise the construction of new tramways entering Paris and to replace them, if possible, by other means of transport. Experiments are therefore to be made on new suburban lines with electric trolley omnibuses. The existing chassis will be used, the only modification being the fitting of an electric motor in the place of the petrol engine and the suppression, of course, of the gear-box. The service in the suburbs is to be accelerated as much as possible, for which purpose the experimental vehicles will run on pneumatic tires. It may be added that, apart from the transport service, several projects are under consideration by the Paris Municipal Council for dealing with the congestion of traffic, and there appears to be a good deal of support for the proposal to construct a subway with moving platform under the main boulevards. Efforts are being made to induce the Council to authorise the construction of an experimental subway under the Avenue de l'Opéra.

Foreign Trade.

The returns of foreign trade during the first nine months of the year may be taken as evidence of a slight recovery, for while there had been previously a rapid declension of imports until they fell below the exports, there was, in September, an improvement in the value of importations. As the arbitrary values fixed for the purpose of Customs valuations are rather misleading, they are now accompanied by the weights. In September these still further emphasised the improvement, which was due almost entirely to the purchases abroad of fuel and raw material. The fact that the French purchases of raw material should have so largely increased is regarded as proof of the greater activity of the manufacturing industries.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

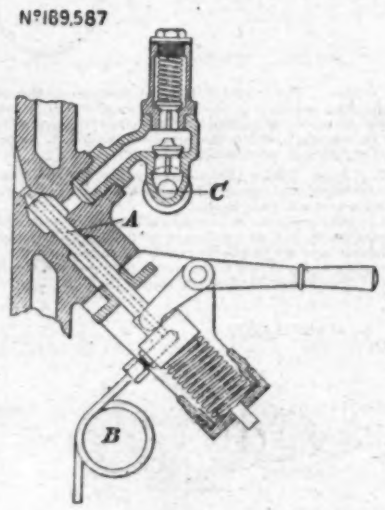
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date at the end of the abridgment is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

169,587. August 5th, 1920.—Fuel-injecting Devices, J. S. White and Co., Limited, East Cowes, Isle of Wight, A. Foster, Bedlburn, Newport-road, Cowes, and G. A. Mellor, Strathmore, Park-road, Cowes.

This is a combined fuel sprayer and starting air valve. The fuel spray A is of normal construction, and can be moved endways, against the pressure of a spring, by means of the hand

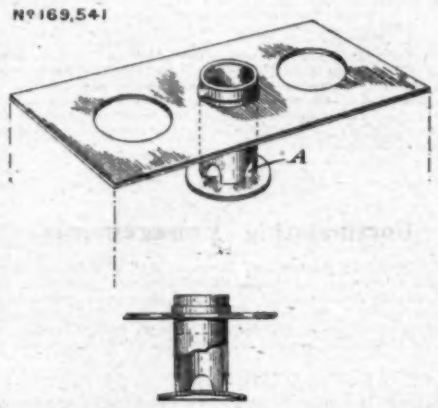


lever shown. The fuel oil is supplied through the flexible pipe B. Air for starting purposes is supplied through the branch C, and is admitted to the cylinder when the spray is lifted off its seating by the hand lever.—*October 6th*, 1921.

STORAGE BATTERIES.

169,541. July 5th, 1920.—Improvements in Electric Accumulators, Saunders Electrical Company, of 38, Bayley-lane, Coventry, and Clement Saunders, of 69, St. Thomas Whiteroad, Coventry.

The object of this invention is to prevent the electrolyte of secondary cells from splashing and coming through the vent pipe. It will be seen that the lower part of the pipe is provided

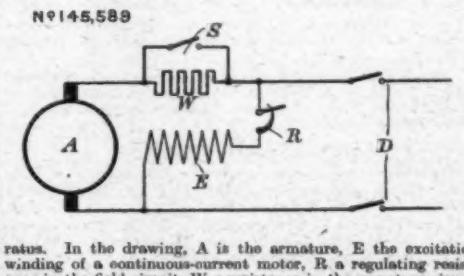


with a baffle and orifices A are made in the pipe. Moreover, as shown in the lower illustration, the baffle may be convex on its upper surface and concave on the lower surface.—*October 5th*, 1921.

DYNAMOS AND MOTORS.

145,589. June 29th, 1920.—An Improved Method of Starting Continuous-current Motors, Oesterreichische Siemens Schuckertwerke, of Engerthstrasse 150, Vienna, Austria.

According to this invention, electric motors are started with comparatively small currents flowing in the controlling appa-

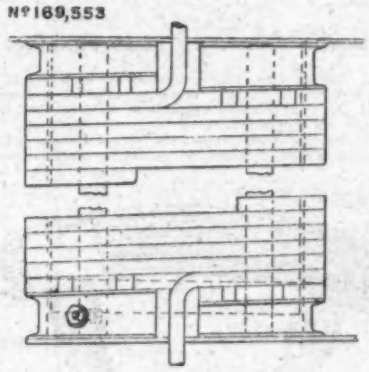


ratus. In the drawing, A is the armature, E the excitation winding of a continuous-current motor, R a regulating resistance in the field circuit, W a resistance in the armature circuit which can be short-circuited by means of a switch S, and D the switch for disconnecting the motor from the mains. After the main switch D has been closed, the current first of all flows only through the armature and is limited by the resistance W to the strength which is just admissible. The field circuit is first excited, either simply by connecting it to the supply or by the gradual insertion of the shunt resistance R. The magnetic field of the motor increases gradually and uniformly, so that the turning moment of the armature gradually increases in the same proportion. After the armature has reached a substantial speed, the resistance W is bridged over by a short-circuit switch, so that the armature brushes are supplied with current at the full voltage, and the motor assumes its final speed.—September 29th, 1921.

TRANSFORMERS.

169,553. July 12th, 1920.—Improvements in or relating to the Manufacture of Coils suitable for use in the Construction of Static Transformers, The British Electric Transformer Company, of Hayes, Middlesex, and Jan Roothaem, of the same address.

The object of this invention is to construct transformer coils so that when the coils are finished the turns will not untwist and cause trouble. The insulated copper conductor is wound upon a former, composed of end rings which are connected together

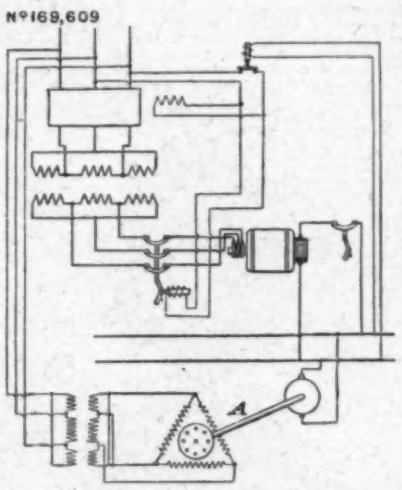


by longitudinal tie rods surrounded by a hollow cylinder of insulating material. One end of the conductor is permanently and rigidly secured to one of the end rings. The conductor is then wound around the cylinder under tension and its other end portion, when the winding is completed, is permanently and rigidly secured to the opposite end ring.—*October 6th*, 1921.

TRANSMISSION OF POWER.

169,609. October 6th, 1921.—Improvements in or relating to Automatic Sub-stations, Metsopolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.

According to this invention, a relatively small-capacity generator A, which has a drooping voltage characteristic, is permanently connected to the load circuit. By the use of this device, normal voltage is maintained on the load circuit to preclude the relays associated with the automatic sub-station operating under conditions which falsely imitate excess load, and the voltage characteristic of the generator is such that, when current is taken therefrom, its voltage rapidly decreases



to permit the relays to respond to the true load condition in the circuit. In the ordinary way, when all the converters of a system are disconnected and there is no load on the direct-current circuit, no voltage is supplied to the automatic relays, and they will start the converters, but owing to the provision of the motor generator A this trouble is avoided. It will be seen from the diagram of connections that the motor generator A is fed from the high-pressure alternating mains, and is therefore independent of the direct-current circuit.—*October 6th*, 1921.

GAS PRODUCERS.

169,580. July 30th, 1920.—Low-temperature Carbonisation, C. W. Toxer, 66, Victoria-street, Westminster.

In this specification a claim is made for the carbonisation of coal or other carbonaceous material, at a temperature ranging between 400 and 600 deg. Cent., with a vacuum of from 70 mm. to 150 mm. of mercury. The gases given off are purified, compressed to a pressure of four or five atmospheres, and suddenly re-expanded with the object of securing the light hydrocarbons in liquid form.—*October 6th*, 1921.

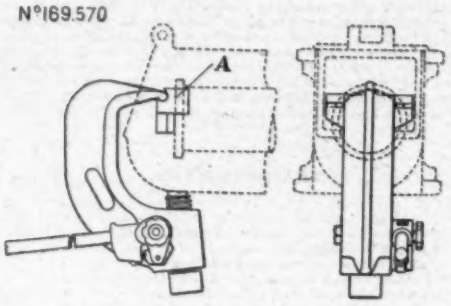
TRAMWAYS AND RAILWAYS.

169,570. July 21st, 1920.—Journal Box Jacks, J. A. Hope, 2165, Waverly-street, Montreal.

This jack is intended for taking the weight off the brasses in railway axle-boxes without it being necessary to pack up the jack on the permanent way. A pad, or block, A is arranged to

catch on to the collar of the journal and bear against the end of the axle. This block is provided with a notch which receives the end of the yoke of the jack. The jack screw, which is operated

N°169,570



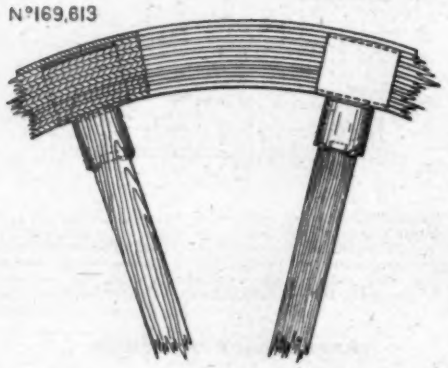
by a worm and ratchet gear, bears underneath the axle box.—*October 6th*, 1921.

MOTOR CARS AND ROAD TRAFFIC.

169,613. August 31st, 1920.—Artillery Wheels, E. S. B. Mackenzie-Hughes, 17, Wykeham-mansions, Rosendale-road, Dulwich, London, S.E. 21, and W. C. Stewart, Dayton Lodge, Shortlands, Kent.

The inventors propose to make the felloes of wagon wheels by building up wooden laminations, with the grain crossed, and

N°169,613



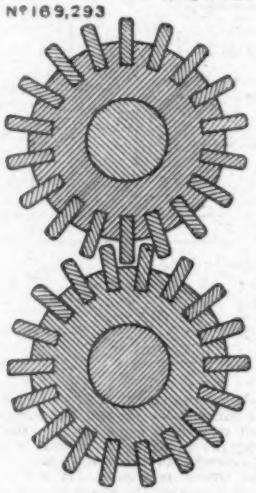
fixing them by waterproof glue. The spokes would be secured to the felloe by means of stamped steel sockets and ferrules. The sockets would be recessed into the woodwork to leave a flush seating for the tire.—*October 6th*, 1921.

MISCELLANEOUS.

169,293. June 25th, 1920.—Decorticating Machines, T. E. Mitchell, Greenfield, Blairgowrie, Perth, and W. Dixon, 38, Bath-street, Glasgow.

This specification is concerned with the proportions of rollers for decorticating flax, &c., which have longitudinal bars, or teeth, that intermesh with one another. The inventors say that experiment has shown that to obtain complete removal of the woody and like matters and obtain in one operation a substantially clean fibre product it is necessary for the minimum

N°169,293



clearance between the intermeshing teeth to lie between 40 per cent. and 80 per cent. of the thickness of the crushed or flattened straw or stems in the rough after passing through plain rollers, that is to say, from 0.02in. to 0.05in. The speed at which the single pair of rollers is driven is preferably considerable—it has been found, for instance, that a velocity of tooth past tooth of from 5000 to 6000 per minute is effective with flax.—*September 26th*, 1921.

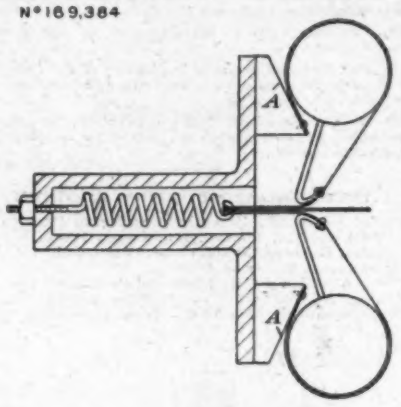
161,949. April 6th, 1921.—A Use for Basalt, La Société Le Basalte, 124, Rue de Provence, Paris.

This specification makes a claim for the use of basalt by melting it and drawing it out into fine threads in the same manner as glass is drawn. The thread is kept for a few seconds at a temperature of about 800 deg. Cent., and is said to be very flexible. It is suggested that the threads may be manufactured into fabrics, cables, cords, submarine cables, &c.—*October 6th*, 1921.

160,384. September 15th, 1920.—Centrifugal Governors, O. Magne, Enebakveien 65, Kristiania, Norway.

This invention has reference to centrifugal governors of the type in which centrifugal weights roll on a surface of the governor and are connected with the governor and the governor spring by means of steel ribbons. In these governors the pressure on the rolling surfaces is dependent upon the tension of the governor spring. Experience has shown that an insignificant wearing of the rolling surfaces completely destroys the calculated effect

N°169,384

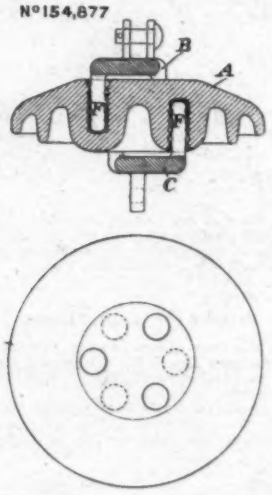


of the rollers. The inventor thus so proportions the several parts that the pressure of the weights on the guiding surfaces is wholly or partly eliminated. This effect is governed principally by the angle which the surfaces, marked A, make with the axis of rotation.—*September 29th*, 1921.

154,877. June 23rd, 1920.—Improvements in Electric Suspension Insulators, Siemens Schuckertwerke G.m.b.H., of Siemensstadt, near Berlin.

This invention relates to suspension insulators provided with two metal parts, having extensions or fingers which engage in the porcelain and are displaced relatively to one another. A is the porcelain body, B and C the metal parts, and F the fingers thereon. The upper illustration shows that the fingers pass

N°154,877



beyond one another in the longitudinal direction, and the lower illustration shows that the fingers of the opposite metal parts taking up the tension are separated from one another by porcelain walls of the required strength. The fingers transfer the strain upon the porcelain through the layer of jute, and the arrangement ensures a uniform strength of the piece of porcelain.—*September 23rd*, 1921.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Electro-Harmonic Society.—The Great Hall, Cannon-street Hotel. Concert (Ladies' Night). 8 p.m.

Physical Society of London.—Imperial College of Science, Imperial Institute-road, South Kensington, S.W. Presidential address: "The Structure of Organic Crystals," by Professor Sir W. H. Bragg. 5 p.m.

Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—University Engineering Building, Liverpool. "Ripples," by Professor L. R. Wilberforce. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Lecture Theatre, Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. "The Working of a Modern Telephone System," by Mr. C. Whillis. 6.30 p.m.

Institution of Electrical Engineers: Scottish Centre, Students' Section.—Room 149, Royal Technical College, Glasgow. Chairman's address, by Mr. Alex. Lindsay. 7.30 p.m.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. Question and general discussion evening. 8 p.m.

West of Scotland Iron and Steel Institute.—"Societies Room," No. 24, Royal Technical College, George-street, Glasgow. "The Present Status of Electric Furnaces in Steel Making," by Mr. Harry Etchells. 7 p.m.

SATURDAY, NOVEMBER 12TH.

Manchester Association of Engineers.—Memorial Hall, Albert-square, Manchester. "The Flow of Metal during Forging," by Mr. F. Massey. 7 p.m.

Junior Institution of Engineers.—Visit to the locomotive sheds of the Great Northern Railway at King's Cross. 2.30 p.m.

Keighley Association of Engineers.—Assembly Rooms of the Cycling Club, Cavendish-street. "Control Gear," by Mr. O. C. Dinnerman. 6.30 p.m.

Institution of Municipal and County Engineers: West Midland District.—Meeting at Birmingham. Programme:—1.45 p.m.: Members to meet at the front entrance of the Council House; 2 p.m.: Motor omnibuses will leave for Cole Hall sewage farm; 2.30 p.m.: Inspection of plant and sewage disposal works; 4 p.m.: Motor omnibuses return to Council House; 4.30 p.m.: Afternoon tea, kindly provided by Mr. J. D. Watson; 5 p.m.: Council Chamber. Members will be received and welcomed by the Right Hon. the Lord Mayor. Paper on "Sewage Gas for Internal Combustion Engines," by Mr. J. D. Watson, and discussion.

MONDAY, NOVEMBER 14TH.

University of London, University College.—Public lecture, "Recent Researches in Photo-elasticity," by Professor E. G. Coker. 5 p.m.

Keighley Association of Engineers.—Visit to the Co-operative Wholesale Society, Limited, Bailey Hall Flour Mills, Halifax. Train leaves Keighley (G.N.R.) 12.48 p.m.

Bradford Engineering Society.—Hall, Bradford Technical College. Lecture: "Electricity and Photography in Modern Warfare," by Mr. Harry Moss. (Lantern.) 7.30 p.m.

Institution of Electrical Engineers: North-Eastern Centre.—Armstrong College, Newcastle. "Telephone Line Work in the United States," by Mr. E. S. Byng. 7.15 p.m.

Institute of Transport.—Institution of Civil Engineers, Great George-street, S.W. "Possibilities of Improving Train Loads," by Mr. H. Kelway-Bamber. 5.30 p.m.

TUESDAY, NOVEMBER 15TH.

Institution of Civil Engineers.—Gt. George-street, S.W. 1. Paper: "The Indian Railway Gauge Problem," by Mr. F. C. Royal-Dawson. 6 p.m.

Illuminating Engineering Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Reports on "Progress during the Vacation and Developments in Gas Lamps and Electric Lamps and Lighting Appliances (with exhibits). 8 p.m.

Institution of Electrical Engineers: North-Western Centre.—Engineers' Club, 17, Albert-square, Manchester. Chairman's address, Mr. W. Walker. 7 p.m.

Institution of Electrical Engineers: North Midland Centre.—Hotel Metropole, King-street, Leeds. Chairman's address by Mr. W. E. Burnand. 7 p.m.

WEDNESDAY, NOVEMBER 16TH.

Thornycroft Engineering Society.—Works Canteen, Basingstoke. "Magnetos," by Mr. D. Hume. 7 p.m.

Society of Glass Technology.—Fuel Department, The University, Leeds. Demonstration of an improved gas reversing valve for regenerative furnaces, by Mr. F. W. Knowles; general discussion on "The Melting of Glass." 2.30 p.m.

The Newcomen Society.—Caxton Hall, Westminster, S.W. Special general meeting. Paper on "The Liverpool and Manchester Railway" (illustrated by contemporary prints) by Mr. C. F. Dendy Marshall. 5 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "Modern Buildings in Cambridge and their Architecture," by Mr. T. H. Lyon. 4.30 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, S.W. 1. The following papers will be read:—(1) "On the Dynamics of Wind," by Dr. Harold Jeffreys; (2) "The Behaviour of Pilot Balloons at Great Heights," by Mr. N. K. Johnson; (3) "The Cloud Phenomenon of November 29th, 1920," by Mr. C. J. P. Cave. 5 p.m.

The Industrial League and Council.—Conference Hall, Central Hall, Westminster, S.W. 1. Annual General Meeting. 5 p.m.

THURSDAY, NOVEMBER 17TH.

The Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. "Telephone Line Work in the United States," by Mr. E. S. Byng. 6 p.m.

Royal Aeronautical Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper: "The Requirements and Difficulties of Air Transport," by Colonel Frank Searle. 5.30 p.m.

East London College: Department of Civil and Mechanical Engineering.—Mile End-road, E. 1. Lecture IV. on "Diesel and Semi-Diesel Oil Engines, the Present Position of the Heavy Oil Engine and the Problems involved in its Further Development," by Engineer-Commander B. W. Knott. 6 p.m.

Manchester Association of Engineers.—Chemical Lecture Theatre, Municipal College of Technology, Sackville-street, Manchester. Lecture: "The Draughtsman, his Duties and Responsibilities," by Mr. J. H. Wright. 7 p.m.

FRIDAY, NOVEMBER 18TH.

Junior Institution of Engineers.—Caxton Hall, S.W. 1. Annual general meeting. 7 p.m.

Junior Institution of Engineers: Midland Section.—Birmingham Chamber of Commerce, New-street, Birmingham. Lecture on "Coal Mining in Great Britain," by Professor K. Neville Moss. 7 p.m.

The Institute of Metals: Sheffield Local Section.—Mappin Hall of University of Sheffield, St. George's-square. Chairman's address: "What is a Metal?" by Professor C. H. Desch. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. "The Machinery of Floating Docks," by Dr. E. H. Salmon. 6 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper: "Steel Tube Making," by Mr. Fred H. Moseley. (Lantern, &c.) 7.30 p.m.

Institute of Transport: Graduates' and Students' Section.—Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Operation and Development of Urban Electric Railway Services," by Mr. J. P. Thomas. 5 p.m.

Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—Rushworth Hall, Liverpool. Lecture: "The Influence of Music on Life." 8 p.m.

FRIDAY, NOVEMBER 18TH, TO FRIDAY, NOVEMBER 25TH

Public Works, Roads and Transport Congress, London. —For programme see page 422.

MONDAY, NOVEMBER 21ST.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, S.W. 1. Paper: "Some Thoughts on Motor Cycle Engine Design," by Mr. John Harrison. (Graduates of Institution of Automobile Engineers invited.) 7 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Informal meeting. Discussion: "Hydro-electric Power," to be opened by Mr. A. J. Hamsworth. 7 p.m.

FRIDAY, NOVEMBER 25TH.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. Lecturette: "Electro-magnetic Instruments: Problems in their Design and Construction," by Mr. G. F. Shotter. 8 p.m.

Institution of Production Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. Paper: "Drawings and Production," by Mr. A. F. Guyler. (Lantern.) 7.30 p.m.